

**Association of material hardship with maternal and child outcomes**

Technical report of cross-sectional analysis of nine-month

data from Growing Up in New Zealand cohort –2018

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**Disclaimer**

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

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# Brief overview of project and its findings

### Material hardship is associated with negative outcomes for mothers and children at nine months of age

Across all the richer nations, low income and material hardship (family poverty) are strongly linked with negative child and maternal outcomes across the lifespan. Family poverty continues to be an area of policy concern. Although poverty is associated with an increased likelihood of negative maternal and child outcomes in New Zealand as elsewhere, we know little about the magnitude of the association for specific outcomes or which developmental and life-course pathways are most influenced by poverty.

A better understanding of the pathways and magnitude of the association between poverty and child and maternal outcomes in New Zealand will inform policy and social investment decisions.

The majority of studies in this area use low income as the poverty measure while this study uses material hardship, reflecting how families are actually living. Data from the Growing Up in New Zealand study (GUiNZ) data set were used to address the question ‘What is the magnitude of the association between material hardship and selected child and maternal outcomes, taking into account factors that might distort[[1]](#footnote-1) the findings?’ This initial study provides cross-sectional baseline estimates of the association, when the children were approximately nine months of age, and frameworks that can be used in future longitudinal analysis of GUiNZ data.

Results show, in line with the international research, a strong association between material hardship and poor child and maternal outcomes. Maternal mental health, child socio-emotional development indicators, living in poor housing conditions, and the number of child respiratory illness are all associated with material hardship.

For several outcomes, whatever the level of hardship, results show an increased likelihood of negative outcomes for those assessed as in material hardship compared with those who were not. In addition, for some outcomes, as the level of material hardship increased the likelihood of a negative outcome also increased significantly.

* Mothers experiencing high levels of material hardship were 4.8 times more likely to have moderate to severe anxiety compared with mothers with no material hardship. Similarly, mothers experiencing high levels of material hardship were 4 times[[2]](#footnote-2) more likely to have a moderate/high probability of depression compared with mothers with no material hardship. As the level of material hardship increased, the likelihood of poor maternal mental health increased significantly.

* Children experiencing high levels of material hardship were, approximately, 3 times more likely to have a high level of negative emotional reactions and twice as likely to have high levels of respiratory conditions/ear infections compared with children not in material hardship. As the level of material hardship increased, children were more likely to experience higher levels of negative emotional reactions.
* Mothers and children experiencing high levels of material hardship were approximately 3 times more likely to be living in a damp house and twice as likely to be living in a crowded household compared with mothers and children with no material hardship.[[3]](#footnote-3) As the level of material hardship increased, the likelihood of living in damp housing increased significantly.

Up to 14 percent of New Zealand children are exposed to material hardship (depending on the definition used) indicating there is potential to reduce a range of negative outcomes for children. Future research on poverty, using the GUiNZ longitudinal data, should deliver a deeper understanding of the pathways between poverty and maternal and child outcomes; provide estimates of the magnitude of the potential causal effect along these pathways; and pinpoint the levers for interventions to reduce harm and increase positive outcomes.

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| **Data used for this study**  The Growing Up in New Zealand study data set has a rich set of information on factors not currently available within administrative data sets. Only cross-sectional data were available for this analysis. As a point-in-time analysis, the research establishes levels of association only. That is the magnitude of the associations (not causation) between levels of exposure to poverty and selected maternal and child outcome indicators is reported. A material hardship scale was developed from the data and used as the measure of poverty. Odds ratios were calculated and these have been converted into risk ratios for ease of interpretation in this overview. In the future, research looking at changes over time has the potential to help determine the direction and magnitude of the association along different causal pathways. |

Refer to the Executive Summary or ‘Section 7 Summary and Conclusions’ for a more complete description of the study and results. Sections 1 to 6 provide full details of the research.

# Executive Summary

## The study assessed the extent to which material hardship is associated with maternal and child outcomes

Material hardship has been associated with many family, child and life course outcomes. Research on the effects of poverty was identified as a policy priority by the Ministry of Social Development. This study was intended as a first step in developing a better understanding of how material hardship influences child and maternal outcomes within a contemporary New Zealand cohort using the GUiNZ data. The research study also provides a baseline and framework for future analyses.

The specific question addressed in the research is ‘To what extent is material hardship associated with child and maternal outcomes taking into account potential confounding and mediating factors?’ The methodological approach and the cross-sectional results provide a base for future longitudinal analyses as originally planned.

The cross-sectional analysis had the following steps:

* development of a valid measure of material hardship
* identification of factors influencing the relationship between poverty (material hardship) and each of the outcomes included in the research, from national and international literature
* development of directed acyclic graphs (DAGs) to map the relationships among factors which then provided the theoretical framework for the analysis
* conducting descriptive analyses
* modelling the relationship between material hardship and outcomes taking into account potential confounding informed by the approaches outlined by Greenland et al (2016), Greenland and Pearce (2015) and Pearl (2010).

The estimates derived from the modelling represent the total level of association of material hardship with specific maternal and child outcomes. That is, the estimates take into account factors that potential confound the relationship between material hardship and the outcome, but exclude factors that potentially mediate the relationship between material hardship and the outcome. The estimate of the total level of association between material hardship and the outcome incorporates the association of these mediators. Estimates of the level of effect for mediating factors require longitudinal data, which was not available for this analysis but are planned for future analyses.

### Outcomes were selected for inclusion based on their relevance to the research question, data availability and data quality

The outcomes included in the analysis were selected on the basis of their relevance to the research question, their availability within the data set, and the quality of the data (eg number of missing values). Outcome data was collected during an interview with the child’s mother approximately nine months after the birth of their child.

The outcomes selected for analysis included:

* maternal depression, that is moderate or high probability of depression as indicated by scores on the Edinburgh Postnatal Depression Scale (EPDS)
* maternal anxiety, that is moderate to severe anxiety as indicated by scores on the General Anxiety Disorder (GAD-7) scale
* infant temperament characteristics as indicated by scores on the Infant Behavior Questionnaire Revised Very Short Form (IBQR-VSF) reflecting precursors to socio-emotional outcomes
* mother and child living in poor quality housing (damp house)
* mother and child living in a crowded household
* the number of child respiratory conditions/ear infections since birth.

### Relationships between material hardship and outcomes, identified in national and international literature, guided the inclusion of factors in the analysis

The theoretical relationships between material hardship and outcomes were derived from national and international literature. These hypothesised causal relationships guided the inclusion of factors in the regression analysis (potential confounding factors) or their exclusion (potential mediators). Potential confounding factors were included in the analysis while potential mediators were excluded because the main aim was to assess the total levels of association of material hardship with the specified outcome. Assessment of mediating factors requires longitudinal data sets. Future longitudinal analyses should be able to assess the extent to which material hardship operates through particular mediators.

Factors may confound the relationship between material hardship and outcomes when they are associated with both material hardship and the outcome, but are not on the causal pathway. In contrast, mediating factors are on the causal pathway between material hardship and the outcome. Mediators may be referred to as explanatory mechanisms or processes, intermediary factors, or intervening factors.

Figure A outlines the relationship of material hardship with maternal depression and anxiety, including potential confounding factors and mediators of the relationship.[[4]](#footnote-4) Similarly, Figure B outlines the hypothesised relationship between material hardship and infant temperament outcomes including potential confounding factors and potential mediators of the relationship. Figure C outlines the hypothesised relationship of material hardship with quality of housing, household crowding and number of child respiratory conditions/ear infections.

**Figure A: Hypothesised pathways between material hardshipa and maternal depression or anxiety with potential confounding factorsb (included in model) and mediating factorc (excluded from model)**

Material hardship box - arrows pointing to relationship quality (green arrow), maternal anxiety or depression (red arrow).
Relationship quality box  - arrows pointing to maternal anxiety or depression (green arrow).
All blue arrows follow.
Perceived social suport box  - arrows pointing to relationship quality, material hardship, maternal anxiety or depression.
Ethnicity (mother) box  - arrows pointing to  Material hardship, relationship quality,maternal anxiety or depression.
Age (mother) box  - arrows pointing to Material hardhsip, relationship quality,maternal anxiety or depression.
Education (mother) box  - arrows pointing to Material hardhsip, relationship quality,maternal anxiety or depression.
Relationship status (mother) box  - arrows pointing to Material hardhsip, relationship quality,maternal anxiety or depression.




a) The main relationship that is assessed in the analysis is depicted by the red arrow, the total level of association between material hardship and the outcome.

b) Potential confounding factors are not on the causal pathway between the exposure (material hardship) and the outcome (for the relationship examined in this research), but they may bias the estimate if not taken into account in the analysis. The hypothesised direction of influence of the potential confounding factors is depicted by a blue arrow drawn from the confounder to the factor(s) it is associated with.

c) Mediating factors are potentially intermediary factors that sit along a causal pathway between the exposure (material hardship) and the outcome. They represent an indirect pathway between the exposure and the outcome. The hypothesised direction of influence of the mediator is depicted with a green arrow from the exposure (material hardship) to the mediating factor and then to the outcome.

**Figure B: Hypothesised pathway of material hardship to child temperament outcomes including potential confounding factors (included in model) and mediating factors (excluded from the model)**

Material hardship red arrow to Child social, emotional developmental outcomes , green arrows to relationship quality, maternal anxiety and depression.

Green arrows
Relationship quality arrows to Maternal anxirty/depression, Child social, emotional, developmental outcomes,Parenting factors practices style and attachment,
Maternal anxirty/depression arrows to Parenting factors practices style and attachment,Child social, emotional, developmental outcomes.
Parenting factors practices style and attachment arrows to Child social, emotional, developmental outcomes.







Blue arrows
Ethnicity (mother) arrows to Maternal hardship, relationship quality, maternal anxiety/depression, Child social, emotional, developmental outcomes
Age (mother) arrows to Maternal hardship, relationship quality, maternal anxiety/depression, Child social, emotional, developmental outcomes
Education (mother) arrows to Maternal hardship, relationship quality, maternal anxiety/depression, Child social, emotional, developmental outcomes
Relationship status arrows to Maternal hardship, relationship quality, maternal anxiety/depression, Child social, emotional, developmental outcomes
Child age, Gender, disability, genetics arrows to Parenting factors pactices style and attachment, Child social, emotional, developmental outcomes



**Figure C: Hypothesised pathway of material hardship to housing quality, household crowding and child respiratory conditions/ear infection with potential confounding factors (included in model)**

Red arrow - Material hardship to Child social, emotional developmental outcomes.

Green arrows
Material hardship to relationship quality, maternal anxiety/depression, parenting factors practices, style, attachment.

Green arrows
Relationship quality to  maternal anxiety/depression. parenting factors practices, style, attachment.  Child social, emotional developmental outcomes.

Green arrows
Maternal anxiety/depression to  parenting factors practices, style, attachment.  Child social, emotional developmental outcomes.

Blue arrows
Ethnicity (mother) arrows to Maternal hardship, housing quality and crowding, child health outcomes
Age (mother) arrows to Maternal hardship, housing quality and crowding, child health outcomes
Education (mother) arrows to Maternal hardship, housing quality and crowding, child health outcomes
Relationship status arrows to Maternal hardship, housing quality and crowding, child health outcomes
Housing tenure arrows to Maternal hardship, housing quality and crowding, child health outcomes
Mother smokes arrows to Maternal hardship, housing quality and crowding, child health outcomes
Child age, Gender, disability, genetics arrow to child health outcomes




## A valid measure of material hardship was developed for use in the analysis

A material hardship scale was developed from GUiNZ mothers’ nine-month interview questionnaire items. Three possible scales were tested using different combinations of the best performing items. The scales discriminate different levels of material hardship but not the full spectrum of material wellbeing. The scale used in the analysis met the requirements of a valid exposure measure for this research.[[5]](#footnote-5) The material hardship scale score or derived categories were used in analyses as a measure of exposure to poverty.

The scale measured the extent of material hardship at a single point in time. As the ante-natal data set did not include material hardship scale items, a measure of duration of exposure to material hardship across the ante-natal to nine-month interview period was not available. All children in the cohort were a similar age and the analysis is cross-sectional, therefore, the ‘age of exposure to material hardship’ was not relevant for this analysis. However, all regression analyses took into account the mother’s age.

Four levels of material hardship were used in logistic regression analyses:

* no hardship items – the reference category (38 percent of the cohort)
* one hardship item (27 percent of the cohort)
* two or three hardship items (22 percent of the cohort)
* four or more hardship items (13 percent of the cohort were in this group).

## Results showed material hardship was associated with all but one of the outcomes in the study

All but one of the outcomes in the study were found to be associated with material hardship. Material hardship was associated with:

* a mother’s likelihood of depression at the nine-month interview
* a mother’s likelihood of anxiety at the nine-month interview
* infant socio-emotional outcomes (temperament) at nine months (two of the three dimensions analysed)
* living in poor quality housing (damp house)
* living in a crowded household
* the number of child respiratory conditions/ear infections during the first nine months.

Infant ‘Effortful Control’ (one of the three infant temperament dimensions) showed no unadjusted association with material hardship and was excluded from regression analysis.

### Material hardship was consistently associated with poorer outcomes but the strength of association varied by outcome type

Overall, results showed that material hardship was significantly associated with all but one of the outcomes included in the study after adjusting for potential confounding. The strength of the association varied across outcomes but the direction was consistent. Higher levels of material hardship were associated with poorer outcomes compared with those with no material hardship across all outcomes (refer to Table A and Figure D).

All three levels of material hardship score categories used in the analysis were significantly associated with the outcome for many of the outcomes including:

* maternal depression
* maternal anxiety
* high infant ‘Negative Affect’ scores
* living in poor quality housing
* high levels of respiratory conditions/ear infections (top 12% of scores).

### For several outcomes, the level of association increased significantly as the level of material hardship increased

Trend analyses across levels of material hardship were significant for the outcomes of maternal depression and anxiety, indicating a dose-response relationship. That is, not only was each level of material hardship significantly different from those without material hardship, each level of material hardship was significantly different from other levels. This means that the greater the level of material hardship, the greater is the likelihood of maternal depression and anxiety.

Trend analysis was also significant across all levels of material hardship in relation to housing quality (damp housing). That is, as material hardship increased, the greater the likelihood the mother and infant were living in a damp house.

A comparison of those with one hardship item compared with those with four or more hardship items was significant for high infant ‘Negative Affect’ and living in a crowded household (more than two people per bedroom) (Table A). For the second measure of living in a crowded household (more than 2.5 people per bedroom on average), the trend was significant between material hardship levels ‘2-3’ and ‘4’, and between material hardship levels ‘1’ and ‘4’.

The only measure which did not have a significant trend analysis across some or all the material hardship levels was the ‘number of child respiratory conditions/ear infections’. This may be a reflection of the relationship between material hardship and child respiratory conditions. However, it may also be due to the imprecision in the respiratory scale which was constructed from categories rather than being a true count variable.

**Table A: Adjusted odds and estimated risk ratiose for significant outcome variablesf by level of material hardship**

|  |  |  |  |
| --- | --- | --- | --- |
| **Outcomes** | **Odds ratio (95% confidence interval)**  **(Estimated risk ratio)d** | | |
|  | **1 hardship item vs no hardship items** | **2-3 hardship items vs no hardship items** | **4 or more hardship items vs no hardship items** |
| Maternal Depressiona | **1.68** (1.30–2.17)\*\*  (1.63) | **2.55** (1.99–3.27)\*\*  (2.39) | **5.00** (3.81–6.55)\*\*  (4.17) |
| Maternal Anxietya | **1.61** (1.20–2.18)\*  (1.58) | **2.62** (1.96–3.50)\*\*  (2.48) | **5.49** (4.02–7.48)\*\*  (4.75) |
| High infant ‘Negative Affect’ (top 3% of scores)b | **1.61** (1.02–2.55)+  (1.6) | **1.75** (1.09–2.80)+  (1.73) | **2.85** (1.73–4.7)\*\*  (2.78) |
| High infant ‘Negative Affect’ (top 13% of scores)b | **1.28** (1.05–1.57)+  (1.25) | **1.65** (1.34–2.03)\*\*  (1.56) | **1.83** (1.43–2.34)\*\*  (1.70) |
| Living in a Damp Housea | **1.49** (1.20–1.84)\*\*  (1.44) | **2.21** (1.79–2.73)\*\*  (2.04) | **3.76** (2.97–4.75)\*\*  (3.11) |
| Living in a Crowded Household >2 per bedroomc | **1.14** (0.89–1.47)  (1.13) | **1.33** (1.04–1.71)+  (1.30) | **2.24** (1.72–2.93)\*\*  (2.08) |
| Living in a Crowded Household >2.5 per bedroomb | **1.13** (0.81–1.57)  (1.13) | **1.37** (0.99–1.90)  (1.35) | **1.85** (1.31–2.62)\*\*  (1.80) |
| Respiratory conditions/ear infections (top 6% of scores) | **1.35** (0.99–1.83)  (1.33) | **1.77** (1.31–2.40)\*\*  (1.72) | **1.84** (1.30–2.61)\*  (1.79) |
| Respiratory conditions/ear infections (top 12% of scores ) | **1.27** (1.03–1.56)+  (1.24) | **1.43** (1.16–1.78)\*  (1.38) | **1.54** (1.21–2.00)\*  (1.47) |

+ p<0.05; \* p<0.01; \*\*p<0.000;

a Trend analysis is significant across all three material hardship category levels .

b Trend analysis is significant between material hardship category levels ‘1’ and ‘4’ only.

c Trend analysis is significant between material hardship category levels ‘2-3’ and ‘4’ and ‘1’ and ‘4’.

d Derived from the odds ratio and the base rate of outcome in the unexposed population. Refer to Appendix 4 for formula.

e Refer to Appendix 4 for an explanation of the terms odds ratio and risk ratio.

f Note: Infant ‘Surgency’ was not included in this table as the statistical significance of associations with material hardship were inconsistent and those that were significant indicated a relatively small association.

**Figure D: Adjusted odds for significant outcome variables by level of material hardship**

Figure D: Adjusted odds for significant outcome variables by level of material hardship

### The level of association was relatively high for several outcomes and the direction is consistent with previous findings

Material hardship had the highest level of association with maternal anxiety, maternal depression and living in poor quality housing as indicated by the odds ratios (and estimated rate ratios) Table A.

The level of association with **maternal anxiety** for the group with four or more hardship items was high. The odds ratio for mothers with four or more material hardship items was 5.5 compared with mothers with no material hardship items, after adjusting for confounding factors. That is, the odds of anxiety for mothers’ with four or more material hardship items were five and half times the odds of mothers’ with no material hardship items. The estimated risk ratio suggests that those with four or more material hardship items had a risk of anxiety approximately 4.8 times of those without material hardship.

The level of the association with **maternal depression**, for mothers with four or more hardship items, was also relatively high. The odds ratio for mothers with four or more material hardship items was 5.0 compared with mothers with no material hardship items, after adjusting for confounding factors. That is, the odds of depression for mothers’ with four or more material hardship items were five times the odds of those with no material hardship items. The estimated risk ratio suggests that those with four or more material hardship items had a risk of depression approximately 4.2 times of those with no material hardship.

These findings are consistent with a range of other evidence (eg Baer et al., 2012; Howard et al., 2014; Kiernan & Mensah, 2009; Kiernan & Huerta, 2008; Mazza et al., 2016; Petterson & Albers, 2009) indicating that material hardship is associated with greater likelihood of maternal depression and anxiety. Maternal depression or anxiety has the potential to influence a mother’s life trajectory but also the development outcomes of her child(ren) (eg Petterson & Albers, 2001; Mazza et al., 2016; Lee & Lee, 2016).

The association of material hardship with a mother and her child(ren) living in **poor quality housing** was not as high as for maternal anxiety and depression but was still relatively high. The odds ratio for mothers with four or more hardship items was approximately 3.8 in relation to those with no material hardship items after taking into account potential confounding. The estimated risk ratio suggests that the risk of living in poor quality housing for those with four or more hardship items was 3.1 times of those with no material hardship. These findings are consistent with other research (eg Perry, 2016; Simpson et al, 2016).

Three dimensions of **infant temperament** were tested but only **‘Negative Affect’** scores were relatively strongly and consistently associated with material hardship. Therefore, the analysis concentrated on this relationship. The adjusted association of material hardship with infant ‘Negative Affect’ was tested with three different cut-off points on the ‘Negative Affect’ scale score (the top two percent, three percent, or 13 percent of scores). Linear regression was also used to test the association. In all analyses, higher levels of material hardship were associated with high infant ‘Negative Affect’ after taking into account potential confounders. As would be expected, as greater numbers of respondents were included in the high ‘Negative Affect’ group, the strength of the association reduced (although statistical precision increased). For the group with four or more hardship items, the odds of high infant ‘Negative Affect’ was approximately 3.3 times (top two percent of scores), 2.9 times (top three percent of scores) and 1.8 times (top 13 percent of scores) the odds of the group with no material hardship items. This relates to risk ratios of approximately 3.2, 2.8 and 1.7, respectively.

The results of the infant temperament dimensions analysis are consistent with the international literature which indicates that exposure to poverty negatively influences socio-emotional development (eg Gershoff et al., 2007). High infant ‘Negative Affect’ has been shown to be associated with internalising and externalising problems later in a child’s development, but high and low ‘Surgency’ and low ‘Effortful Control’ dimensions were only problematic when associated with high ‘Negative Affect’ (Gartstein, Putnam, & Rothbart, 2012).

The level of the association between material hardship and living in crowded households and was not as high the outcomes discussed above. However, the direction of the association is consistent with previous research (eg Ministry of Health, 2014; Perry, 2016).

## Conclusion

Results show, in line with the international research, a strong association between material hardship and poor child and maternal outcomes. Maternal mental health, child socio-emotional development indicators, and the number of child respiratory illnesses are all associated with material hardship. As expected, material hardship was associated with living in poor quality housing and living in crowded households.

Up to 14 percent of New Zealand children are exposed to material hardship suggesting there is potential to reduce a range of negative outcomes for this group. Future research on poverty, using the GUiNZ longitudinal data, should provide a deeper understanding of the pathways between poverty and maternal and child outcomes; the magnitude of the effect along these pathways; and pinpoint levers for interventions to reduce harm and increase positive outcomes.

# Introduction

## Family poverty is strongly linked to outcomes across the lifespan and continues to be an area of policy concern

Ensuring the wellbeing of New Zealand’s children is a goal and an ongoing commitment for parents, wider family members, communities, schools, NGOs and government. Shonkoff et al. (2012) note that “building a strong foundation for healthy development in the early years of life is a prerequisite for individual well-being, economic productivity, and harmonious societies around the world”. One of the factors strongly associated with children’s wellbeing and healthy development is “family poverty”, whether understood as low income or material hardship (Boden, Fergusson, & John Horwood, 2013; Cooper & Stewart, 2013; Dickerson & Popli, 2012; Duncan, Morris, & Rodrigues, 2011; Duncan, Ziol-Guest, & Kalil, 2010; Gershoff, Raver, Aber, & Lennon, 2007; Mayer, 2002; Poulton & Ramrakha, 2012; Poulton et al., 2002).

Poverty continues to be an area of policy concern and debate. In a series of reports, requested by the New Zealand Children’s Commissioner, an ‘Expert Advisory Group on Solutions to Child Poverty’ explored how New Zealand can reduce child poverty and mitigate its effects (Expert Advisory Group on Solutions to Child Poverty, 2012a, 2012b; Expert Advisory Group on Solutions to Poverty, 2012; Poulton & Ramrakha, 2012).

More recently, the Child Poverty Reduction Bill has been introduced. The Rt Hon Jacinda Adern stated that “The purpose of this bill is to encourage a focus on child poverty reduction, facilitate political accountability against published targets, require transparent reporting on child poverty levels, and create a greater commitment by Government to address child well-being.”[[6]](#footnote-6)

### The definition of poverty used in New Zealand focuses on unacceptable financial or material hardship

The definition of poverty adopted by Perry (2015a), for use in the Ministry of Social Development’s analysis of material wellbeing in New Zealand, focuses on ‘unacceptable financial or material hardship’ and is *“exclusion from the minimum acceptable way of life in one’s own society because of inadequate resources”* (Perry, 2015a; p. 83). This definition is consistent with the European Union, United Nations Children’s Fund (UNICEF), and others. Perry notes that the definition includes both resources and outcome elements which are reflected in the use of both income-related and non-income measures of hardship for assessing poverty (Perry, 2015a, 2015b).

A similar, but much broader definition was adopted by the Children’s Commissioners expert group “*Children living in poverty are those who experience deprivation of the material resources and income that is required for them to develop and thrive, leaving such children unable to enjoy their rights, achieve their full potential and participate as full and equal members of New Zealand society*” (Expert Advisory Group on Solutions to Poverty, 2012, p.2). Both income-related and non-income related measures are referred to in the Children’s Commissioner’s definition as well, but the wellbeing outcomes are wider and more aspirational than in the one used by Perry (2015a). The Child Poverty Reduction Bill uses the narrower definition of poverty for measurement and considers the wider wellbeing issues in the child wellbeing aspects of the Bill.

### Up to 14 percent of New Zealand children experience material hardship depending on the definition used

Levels of family and childhood poverty in New Zealand vary depending on the measure and thresholds used (Perry, 2015a, 2015b). Evidence using non-income measures of hardship, indicates that around one in seven (14 percent or 155,000 in 2015) New Zealand children live in households with material deprivation scores below an internationally comparable threshold used by the European Union (EU) (Perry 2017 p.74 Table G.2). Using the EU’s ‘severe deprivation’ threshold, the rate for New Zealand children was approximately eight percent in 2014 (Perry, 2017)[[7]](#footnote-7).

New Zealand longitudinal research (covering a time span of four years) indicated that one in five Māori and Pacific children, young children (0-4 years) and children from the most deprived neighbourhoods experienced persistent deprivation (over a period of two to four years) (Gunasekara & Carter, 2012). These findings accord with cross-sectional studies of material wellbeing and hardship which show a higher percentage of: Māori and Pacific people experience deprivation when compared with the percentage of these groups in the population; children aged less than 17 experience deprivation compared with the percentage of this group in the population; and people on income-tested benefits experience deprivation compared with the percentage of this group in the population (Perry, 2015b, pp.29-31).

### Evidence shows that poverty is linked with a broad range of outcomes

A substantial body of international literature now exists linking family poverty and depressed living standards with a broad range of more negative outcomes for children and their parents. These include outcomes in the areas of infant health, infant mortality, overall levels of child wellbeing and development, cognitive development, social-emotional development, school achievement, parental health, parental conflict, teenage pregnancy, and crime (Barber, 2011; Boden, Fergusson, & John Horwood, 2008; Boden et al., 2013; Cooper & Stewart, 2013; Dickerson & Popli, 2012; Duncan et al., 2011, 2010; Gershoff, Raver, Aber, & Lennon, 2007; Mayer, 2002; Poulton & Ramrakha, 2012; Statistics New Zealand, 2012; Weightman et al., 2012).

Children growing up in environments that lack adequate financial resources for basic family needs are more likely to have poorer health and cognitive development outcomes. The negative impacts tend to persist and these children often go on to do less well in education, complete less schooling, work less and earn less as adults. A limited number of studies have shown that the timing, duration and depth of poverty also has influence on child outcomes (Brooks-Gunn & Duncan, 1997; Magnuson, 2013).

### Further work on identifying causal relationships and risk and protective factors is needed to inform policy

A critical issue that concerns researchers and policy makers alike is the extent to which growing up in a family with financial and material hardship causes negative child and family outcomes. There is a growing body of evidence making use of a range of data types and sophisticated analytical techniques which seek to untangle the effects of confounding variables, identify mediating pathways and determine causal relationships (Akee et al., 2008; Dickerson & Popli, 2012; Duncan et al., 2011, 2010; Gershoff et al., 2007; Melchior et al, 2007).

A recent New Zealand study by Gibb et al. (2012) showed that poor economic circumstances in childhood are associated with a range of negative outcomes. After adjusting for covariates, there was evidence of direct linkages with later educational and economic outcomes, but linkages with "later psychosocial outcomes are mediated by a series of social, individual and family factors raising complex unresolved issues about causal pathways" (p.1986). Boden et al. (2013) showed, in a New Zealand study, that material hardship and the variation in family living standards is the outcome of a complex mix of economic, family, individual, and childhood factors, as well as low income.

## Research aims

The analysis described in this report comprises an initial phase of research aiming to increase understanding of the nature of the relationship between the experience of poverty and family and child outcomes within a contemporary New Zealand context. A more detailed and nuanced understanding of these relationships will better inform public policy, and support the development of policy interventions.

The immediate aim of this research was to use Growing Up in New Zealand (GUiNZ) data to identify child and maternal outcomes (from the GUINZ nine-month interviews) that are associated with poverty taking into account social, demographic, family and contextual factors. Beyond this immediate aim, the study aimed to lay the foundations for more comprehensive analysis of these issues over the life-course, as more GUiNZ data waves become available.

The scope of the initial analysis was refined due to the availability of data sets[[8]](#footnote-8) and key data when the project was initiated. Therefore, this report covers the development and application of a material hardship indicator of poverty, but excludes the incomes approach to poverty measurement.[[9]](#footnote-9) This first stage of the research also concentrates on developing the conceptual and methodological framework and baseline estimates for future longitudinal analyses.

As the analysis described in this report is cross-sectional, reported results indicate the level of association between material hardship and selected child and maternal outcomes (taking into account potential confounding).

The **research question** for this initial phase was:

‘To what extent is material hardship associated with child and maternal outcomes taking into account potential confounding and mediating factors?’

## Methods included developing a measure of material hardship and modelling its relationship with outcomes

The research had four methodological components which were to:

1. develop a measure of poverty (material hardship) from the GUiNZ data using a deprivation indicator approach
2. describe the patterns of association between poverty and selected child and maternal outcomes
3. identify factors at antenatal and nine months that are associated with poverty as measured in the 9-month data
4. model the underlying statistical relationship taking into account potential confounding (eg age, gender, ethnicity) and mediating factors.

The broad steps used in this research are outlined below with more detail within each of the sections in the report.

### A material hardship scale was developed to measure the level of exposure to poverty

The development of a material hardship scale involved:

* an examination of the ‘difficulty’ and ‘discriminatory’[[10]](#footnote-10) contributions of potential material hardship items using Item Response Theory (IRT)
* an exploratory factor analysis of three possible scales
* a confirmatory factor analysis to test the dimensionality of the data and goodness of fit of the model
* testing the index reliability/internal consistency of the scale
* concurrent validity testing using selected variables from within the data set.

Currently, MSD’s non-income measures of poverty that are used in reporting levels poverty in the New Zealand population include the Material Wellbeing Index (MWI) and DEP-17 (Perry, 2017). The ten items in the material hardship scale, developed for this analysis, correspond reasonably well with those in the DEP-17 and the hardship items in the MWI although both the DEP-17 and MWI have more items in them. The majority of the material hardship scale items used in this study relate to economising behaviours.

### Factors influencing the relationship between material hardship and outcomes were identified

The identification of important factors in the relationship between poverty and child and maternal outcomes and the description of the underlying assumptions about the relationships between variables (refer to Greenland et al. 2016; Greenland & Pearce 2015; Pearl 2010) involved:

* reviewing the literature on poverty and its relationship with child outcomes to identify relevant factors
* identifying from the literature whether these factors operate as mediators/intermediaries, moderators, or potential confounders
* developing Directed Acyclic Graphs (DAGs) (as per Greenland et al., 1999) to map the relationships which would provide the theoretical framework for the analysis including adjusting for confounding
* identifying variables in the GUiNZ data set which map to the overarching framework.

There is debate about the precise definition of confounding (eg Shahar, n.d.; Shahar & Doron, 2012; VanderWeele & Shpitser, 2013; VanderWeele & Shpitser, 2011) in recent literature. In this research, the criteria used for identifying potential confounding factors was that the factor was: identified in the literature as associated with exposure and/or outcome; had an unadjusted association with both the exposure (material hardship) and the outcome in the GUiNZ analysis; and was not an intermediary (that is, a factor that the literature indicated was on the causal pathway and mediated the relationship between the exposure and outcome).[[11]](#footnote-11)

Mediating or intermediary factors are factors affected by material hardship which in turn influence the outcome of interest. These factors are excluded from regression analyses designed to estimate the net (total) association of an exposure with an outcome (Greenland et al., 2016; Greenland & Pearce, 2015). Also removed from analyses are those factors which are influenced by the outcome.

### Descriptive analyses were conducted prior to modelling

Descriptive analyses of relevant GUiNZ variables were conducted to consider the strength of the relationship between exposure and each outcome and ensure the data are meaningful for analysis and meet model assumptions.

### The relationship between material hardship and outcomes was modelled taking into account potential confounding

The underlying statistical relationship between material hardship and specific outcomes was modelled according to the theoretical relationships depicted in the DAG. The aim of the modelling analysis was to estimate the level of effect (association in this case) of exposure variable X (material hardship) on the outcome variable Y (selected outcomes) while taking into account potential confounding variables.

The modelling approach was informed by Greenland, Daniel, & Pearce (2016) and Greenland & Pearce (2015). The approach adds potential confounders to the model based on the theoretical framework to identify net total effect (i.e., it excludes intermediaries/mediators on the causal pathway) (Greenland et al., 2016; Greenland & Pearce, 2015). The strategy is intended to maximise accuracy of the net total effect estimate of the exposure variable, not confounder effects. A manual forward selection process was chosen.

At each stage, model statistics were generated using the fitstat command in STATA 14 to assess the contribution of the factor to the model.[[12]](#footnote-12) The Hosmer-Lemeshow goodness of fit test was applied at each step and the final models checked with Pearson tests.

Odds ratios were converted to risk ratios for each of the estimates using the approach outlined in Appendix 4. Further details on the approach for modelling the outcome variables are described in sections 4 to 6.

### The GUiNZ mothers’ nine-month interview data, child-related data and several antenatal interview data items were analysed

The GUiNZ data sets used in the analyses were approved for use by the GUiNZ Data Access Committee in August 2016 and the data were made available by October 2016.

The data used for this analysis were obtained from the GUiNZ participants’ interviews. These interviews were the mothers’ ante-natal and nine-month face-to-face interviews (the latter was conducted approximately nine months after the child’s birth) which included child proxy interviews.

Four separate data sets were linked including the data set containing the anonymised identity (id) numbers for the children and parents, the mothers’ antenatal data set, the mothers’ nine-month data set and child proxy interview. A total of 6371 observations remained in the data set after data were linked. Only observations where the mother’s identification number matched across all data sets (antenatal, six weeks and nine months after birth) formed part of the final data set. In cases of twins or triplets, information from only one of the children was included in the linkage.[[13]](#footnote-13) All 6371 matched observations were used in the analysis except in the modelling where missing data led to the exclusion of cases from models. (Refer to Appendix One for more details of the data set linkage.)

## Structure of this report

The next section in this report describes the development and testing of the material hardship scale used as a measure of level of exposure to poverty. This is followed by a description of the GUiNZ cohort included in the analysis. The three following sections describe the analyses and results for the selected outcomes. Section 4 describes the results for the association of material hardship with maternal depression and anxiety. Section 5 describes the results in relation to child temperament outcomes. Section 6 describes the results for living in poor quality housing, living in crowded households and the number of child respiratory conditions/ear infections. Section 7 summarises the approach and results and outlines strengths and limitations of the research.

# Material hardship scale development

## A material hardship scale was developed as the main exposure variable

A measure of material hardship was developed as a proxy measure of level of exposure to poverty. This section describes the development of the material hardship scale derived from the GUiNZ data, prefaced by a brief description of a framework that outlines the factors influencing levels of household material wellbeing.

#### Factors influencing levels of household material wellbeing

Perry (2016) described a framework for considering the relationship between levels of material wellbeing and household income, financial and physical assets, and other factors (Figure 1). It illustrates how households with similar incomes may experience different levels of material wellbeing due to different levels of assets and other factors which affect the resources available for consumption within households.

Figure 1: Factors influencing levels of household material wellbeing

Figure 1: Factors influencing levels of household material wellbeing

Source: Perry (2016)

Within this framework, the concept of material wellbeing includes both positive and negative material wellbeing. Material hardship is on the negative end of the material wellbeing or living standards dimension.

Material wellbeing is conceptualised as the consequence of income level, financial and physical assets and a range of other factors (eg Boden et al. 2013). However, the main focus of this research is the effect of material hardship on specific outcomes. As such, this investigation starts at the end point of Figure 1. Therefore, factors antecedent to material wellbeing were not incorporated in the analysis. Ideally, the full spectrum of material wellbeing would have been included in the analysis. However, the GUiNZ survey questions did not include items relating to all levels of material wellbeing, only material hardship. Therefore, the investigation was not able to discriminate among those with reasonable or very good levels of material wellbeing.

#### The material hardship scale is the measure of poverty used in this investigation

The material hardship scale developed for this research provides a measure of a participant’s level of poverty. Perry (2017 p.8) notes that “In the more economically developed countries … poverty is generally understood as exclusion from a minimum acceptable way of life (standard of living) in one’s own society because of inadequate financial and material resources. A household is considered ‘poor’ when its resources are not adequate to meet its consumption needs for the basics or necessities. While it is not an absolute subsistence notion (‘starvation’), neither is it ‘just relative’. Poverty is not just about having ‘less than’, it is about ‘not having enough’.”

The material hardship scale is used to consider its association with selected child and maternal outcomes. The results of the latter analyses are described in sections 4-6.

As noted in the introduction, although a separate analysis of income-related poverty measures had been mooted in the initial proposal, it was decided to concentrate on the material hardship measure, as material hardship had much lower levels of missing data than the household income data (less than one percent compared with 14 percent). The lower level of missing data potentially reduced selection bias in the sample and retained variance across a range of factors. Future analyses may use the income data, provided sufficiently sensitive equivalised household income measures can be developed from the aggregated income categories within the GUINZ dataset.

### The material hardship scale was developed from mothers’ nine-month interview data items

The GUiNZ mothers’ nine-month data set included 12 potential material hardship items.[[14]](#footnote-14)

Six items had been drawn from the eight-item New Zealand Individual-level Deprivation Index (NZiDep) measure (Salmond, Crampton, King, & Waldegrave, 2006; Tobias & Mason, 2010; Gunasekara & Carter, 2012). A further two items included in the NZiDep were able to be derived from other questions. However, these two NZiDep items relating to benefit receipt and mother’s unemployment within the past year were included in an initial analysis but were subsequently excluded because, conceptually, they were not a direct measure of material hardship (refer to Figure 1) and because one item (unemployment) did not perform well in the initial Item Response Theory (IRT) analysis.

Another two potential material hardship questions related to the affordability of medical care/pharmaceuticals for the baby and not filling prescription for the baby due to cost. Similar items have been used in the New Zealand Health Survey (NZHS)[[15]](#footnote-15) except that the medical care question in the NZHS was restricted to GP services. In the 2011/2012 and 2012/2013 years (which are the NZHS data collection years closest to the time period of GUiNZ data collection used in this research) 2.2 percent and 2.5 percent respectively of new-borns to four year olds had an unmet need for GP services due to cost, as indicated by caregiver responses. For unfilled prescriptions due to cost, the percentages were 7.2 percent and 4.0 percent.[[16]](#footnote-16) Note that these percentages differ from those obtained in 2015/16.

One further potential material hardship item related to whether the respondent had access to the internet at home. In the 2013 Census, 76.8% of households had access to the internet.[[17]](#footnote-17)

Self-assessed financial stress was also covered in one of the GUiNZ questions. Two possible items were developed from this question. One item indicated whether or not money problems were a source of high stress for the respondent and their family since the baby was born. The alternative item indicated whether or not money problems were a source of moderate or high stress.

## Methods used to develop and test the scale

To develop the hardship scale, the research used:

1. An examination of the difficulty[[18]](#footnote-18) and discriminatory[[19]](#footnote-19) contributions of test items, using Item Response Theory (IRT) item response curves from a two parameter model (Rabe-Hesketh & Skrondal, 2008; Skrondal & Rabe-Hesketh, 2007; Streiner, Norman, & Cairney, 2015). This is an item level analysis, which considers the performance of the individual items in relation to a scale.
2. Exploratory factor analysis of three possible scales to determine whether the items in the scale loaded primarily onto the main factor. This tests the assumption of the unidimensionality.
3. Confirmatory factor analysis to test the unidimensionality of the scale and goodness of fit of the model taking into account covariance between items. An assumption was that the scale’s items would form a unidimensional scale, hence the use of confirmatory factor analysis.
4. Estimates of index reliability/internal consistency, using Cronbach’s alpha and correlations between each item and the scale and between each item and the rest of the scale items.
5. Concurrent validity testing using selected variables from within the data set which are known (from the literature) to be associated with material hardship. This provided evidence as to whether the scale was measuring material hardship.

All items were included in the initial IRT analysis including the unemployment and benefit receipt items (step 1). Items were then retained or removed from the scale depending on their individual performance in the IRT analysis. Criteria for removing an item from the scale were that:

* it did not perform well in the IRT analysis (that it had low levels of discrimination)
* it did not load on the main factor in the EFA analysis
* it did not fit conceptually with a measure of material hardship;[[20]](#footnote-20)
* its removal improved internal consistency or modelling statistics.

The remaining items were combined into three possible scales and the performance of these three scales was then tested using steps three to five.

All statistical analyses were conducted in STATA14 or STATA15 using the Item Response Theory, Structural Equation Modelling or descriptive statistics components within that software. SAS Enterprise Guide 7.1 was used initially to manage the data and create new variables for use in the statistical analysis.

### Binary response items were used to develop the scale

As noted above, 12 potential scale items were included in the initial analysis (Table 1 lists all the tested items).

Most (nine) items were binary responses to closed option (Yes / No) questions, while three were derived from other questions by identifying a category from within a question as an endorsement for the item. Therefore, all items used to develop the scale were binary, but the underlying latent variable represented by the scale was assumed to be continuous. Two versions of the item relating to self-identified money problems were tested. The first included “moderate and high stress” due to money problems and the second included only “high stress due to money problems”.

#### Overall, scale items had very few missing values

All but one of the 12 potential items had very few missing values. Across the 11 items with fewer missing values, two to 14 of the 6,371 observations had missing values, representing less than one percent of the responses to each item. All missing values were assigned zero for the item (that is, the response became non-endorsement of the item rather than missing).

The item relating to a mother’s employment had a relatively high level (five percent) of missing responses. Some error may have been introduced by assigning missing values a zero (non-endorsement of the item). In the event, this item was not included in the final scale as it did not perform well in the IRT analyses (see below).

All, but two, of the 12 items were derived from the nine-month interview survey as most of the questions were asked in that interview but not the antenatal interview. The item relating to employment was derived from the antenatal interview, primarily because employment within nine months after the birth of the child(ren) was not considered a reliable indicator of the mother’s employment status more generally. Benefit receipt status was derived from both the antenatal and nine-month interviews. However, both these items were not included in the final scale.

The percentage of respondents endorsing each item ranged from 3.3 percent to 49.9 percent (Table 1).

Table 1: Percentage of respondents endorsing each potential hardship item

|  |  |
| --- | --- |
| **Potential Hardship Item** | **Percent endorsing item**  **(N=6371)** |
| **In the last 12 months have you personally: been forced to buy cheaper food so that you could pay for other things you neededa** | 49.9 |
| **In the last 12 months have you personally: put up with feeling cold to save heating costsa** | 18.3 |
| **In the last 12 months have you personally: made use of special food grants or food banks because you did not have enough money for fooda** | 12.8 |
| **In the last 12 months have you personally: continued wearing shoes with holes because you could not afford replacementsa** | 10.8 |
| **In the last 12 months have you personally: gone without fresh fruit & vegetables often, so you could pay for other things you neededa** | 12.4 |
| **In the last 12 months have you personally: received help in the form of food, clothes or money from a community organisation (like Salvation Army)a** | 5.3 |
| **In the last 12 months have you personally: had any difficulty paying for medical care or medicines that your baby neededb** | 3.5 |
| **In the last 12 months have you personally: ever obtained a prescription for baby from the doctor, but didn’t collect one or more items from the chemist because you could not afford itb** | 3.3 |
| **No access to internet at homec** | 16.5 |
| **Since the baby was born, money problems were a source of moderate or high stress** | 35.3 |
| **(OR) Since the baby was born, money problems were a source of high stress** | 13.6 |
| **(Derived item) Benefit receipt (prenatal or postnatal)a** | 22.5 |
| **(Derived item) Unemployed (prenatal)a** | 7.4 |

a Items used in NZiDep

b Similar items used in NZ Health surveys

c Similar item in 2013 Census

#### Scale construction

An unweighted sum of the binary items (zero or one) was used to construct the scale.

## Results

### Item Response Theory (IRT) analysis using all potential items

The difficulty and discrimination estimates of the items were obtained from an IRT analysis. These estimates informed initial decisions about an item’s inclusion in the scale and subsequent analysis.

#### Most items performed relatively well and covered the spectrum of low to higher levels of material hardship

The level of material hardship on the scale is represented by theta in the Item Characteristic Curve (Figure 2). No material hardship is on the left of the x-axis (negative theta) and higher material hardship on the right of the x-axis (positive theta).

An item’s ‘difficulty’ score indicates where the item functions along the material hardship scale. Results indicated item ‘difficulty’ scores were:

* clustered between 1.11 and 2.45 except for ‘Forced to buy cheaper food’ (.0066) (excluding the unemployment item), refer to the Item Characteristic Curves in Figure 2 and Appendix 2 for all coefficient values
* all positive, that is there were no negative item ‘difficulty’ scores, indicating the items did not cover the full spectrum of material wellbeing, only material hardship.
  + The item relating to purchasing cheaper food had the lowest theta value of zero (.0066).
  + The highest theta score items were ‘Diff. paying baby med. Care’ and ‘Baby prescription not affordable’ (2.35 and 2.45 respectively) apart from the unemployment item.

Item ‘discrimination’ values indicate how well it separates respondents with material hardship below the item location from those with material hardship above the item location. Values above 1.35 are considered high and above 1.7 very high (Streiner et al. 2015). Item ‘discrimination’ values showed that:

* The item relating to ‘unemployment’ status (prenatal) had little discrimination (.76, Appendix 2). It was therefore excluded from further consideration within the analysis.[[21]](#footnote-21)
* All other items, except ‘High stress money problems’ had item discrimination coefficient estimates between 1.42 and 3.71 indicating high to very high discrimination (Refer to Appendix 2 for values). The ‘High stress money problems’ item had a discrimination value of 1.15 which indicated good discrimination; whereas the ‘Moderate or high stress money problems’ item had a slightly lower discrimination value of 1.02.

Figure 2: Item Characteristic Curves for all potential items

#### Figure 2: Item Characteristic Curves for all potential items

#### Unemployment and benefit receipt items were excluded from further analysis

The IRT results indicated that 11 items performed relatively well in the scale. Both the ‘unemployment’ and ‘benefit receipt’ items were excluded from the following analyses because the ‘unemployment’ item did not perform well in the IRT analysis and because, conceptually, both the ‘unemployment’ and ‘benefit receipt’ items are not directly related to a measure of material hardship.[[22]](#footnote-22)

### Three possible scales were tested from the remaining items

Ten items remained for use in the scale construction, forming three possible scales.

(1) The first was a ten item scale with all the remaining items with the high stress self-identified money problems item.

(2) The second was a ten item scale with all the remaining items with the moderate and high stress self-identified money problems item.

(3) The third was a nine item scale which excluded the self-identified money problems item.

### Exploratory factor analysis results

Exploratory factor analysis, using polychoric correlations as recommended for binary items,[[23]](#footnote-23) indicated that the terms loaded primarily onto one factor.[[24]](#footnote-24) Similar loadings on the first factor were obtained for each of the three scales tested (Table 2). The ratio of the eigenvalues of the first factor to the second factor was high supporting unidimensionality.

Table 2: Results from exploratory factor analysis (unrotated)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Scale: 10 items**  **High stress money problems** | **Scale: 10 items Moderate & high stress money problems** | **Scale: 9 items** |
| ***Eigenvalue first factor*** | 5.08083 | 5.04692 | 4.79848 |
| ***Eigenvalue next factor*** | 0.59887 | 0.59122 | 0.57651 |
| **Items** | **Factor loadings first factor** | | |
| **Forced to buy cheaper food** | 0.7048 | 0.7092 | 0.6892 |
| **Feeling cold to save heating costs** | 0.7083 | 0.7083 | 0.7110 |
| **Using food banks as not enough money** | 0.8443 | 0.8460 | 0.8509 |
| **Wearing shoes with holes** | 0.7105 | 0.7125 | 0.7068 |
| **Without fresh fruit & vege due to cost** | 0.7725 | 0.7704 | 0.7703 |
| **Help (food clothing money) from community organisation** | 0.7898 | 0.7899 | 0.7981 |
| **No access to internet at home** | 0.5419 | 0.5435 | 0.5514 |
| **Difficulty paying for medical care for baby** | 0.7483 | 0.7450 | 0.7403 |
| **Prescription for baby not affordable** | 0.7147 | 0.7114 | 0.7155 |
| **Money problems a source of high stress or a source of moderate and high stress** | 0.5290 | 0.4949 | - |

### Confirmatory factor analysis results

Confirmatory factor analysis (CFA)[[25]](#footnote-25) was conducted using Structural Equation Modelling (SEM) in STATA14. However, as the items were binary, the SEM approach used tetrachoric correlations as advised by the Institute of Digital Research and Evaluation (IDRE).[[26]](#footnote-26) The results from the analysis for the main models are detailed in Table 3.

The best performing scale was the 10 item scale using the self-identified high stress from money problems item; although the relative performance of the models was similar. The results depended on the covariance structure that was taken into account in the SEM. Improvements in model performance for Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI), were dependent on the covariance allowed between items. The two items with the highest levels of covariance in the SEM were: ‘Going without medical care baby’ and ‘Going without prescription baby’.

Table 3: Results from SEM modelling using tetrachoric correlations allowing for some covariance among error terms

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **CFA SEM RMSEA allowing error corr.a** | **CFIb** | **TLIc** | **model vs. saturated (given the large sample size significance level has been ignored)** |
| Ten item scale (High stress money problems | 0.071  (0.067-0.075) | 0.982 | 0.962 | chi2(22) = 727.40  Prob > chi2 = 0.0000 |
| Ten item scale (Moderate and high stress money problems) | 0.083  (0.079-0.088) | 0.973 | 0.948 | chi2(23) = 1041.91  Prob > chi2 = 0.0000 |
| Nine item scale | 0.090  (0.085-0.095) | 0.975 | 0.948 | chi2(17) = 896.86  Prob > chi2 = 0.0000 |

a STATA14 uses Browne and Cudeck approach where good fit is where RMSEA < 0.05, adequate fit between 0.05 and 0.08 and poor fit >0.1.

b Good fit indicated by CFI>0.95.

c Good fit indicated by CFI>0.95.

### Measures of internal consistency

Cronbach’s alpha was used to test the internal consistency of the three scales. (Refer to Appendix 2 for full details.)

Similar results were obtained for all tested scales. Of the final three scales, the scale with the highest alpha value (.731) was the 10 item scale with the self-identified ‘high stress from money problems’, followed by the 10 item scale with ‘moderate and high stress from money problems’ item (.724). The nine item scale’s alpha co-efficient was .722.

Acceptable alpha values range from 0.70 to 0.95 (Tavakol & Dennick, 2011). For research situations alpha values of 0.7 to 0.8 are regarded as satisfactory (Bland & Altman, 1997).

#### Item-scale (point biserial) correlations and item-rest of scale correlations

The point-biserial correlations (item-scale correlations) are detailed in Table 4 for the 10 point scale with the ‘high stress from money problem’ item. These correlations indicate an item’s strength of association with the total scale score (item-scale) and with the all other items (item-rest). The item-rest correlation is provided as each item is not independent of the full scale (Table 4). (Refer to Appendix 2 for details on all three scales). These correlations are reasonable and concur with the factor analyses that the items are related.

Table 4: ‘Item-scale’ and ‘Item-rest of scale’ items correlations for the 10 item high stress scale

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Item-test coefficient values (rpbi)** | **Item-test correlation**  **t value** | **Item-test significance** | **Item-rest of scale correlations** |
| **Forced to buy cheaper food** | 0.6223 | t= 63.4366 | P>|t| = 0.0001 | 0.4001 |
| **Feeling cold to save heating costs** | 0.6257 | t= 64.0063 | P>|t| = 0.0001 | 0.4641 |
| **Using food banks as not enough money** | 0.6633 | t= 70.7362 | P>|t| = 0.0001 | 0.5364 |
| **Wearing shoes with holes** | 0.5724 | t= 55.7050 | P>|t| = 0.0001 | 0.4368 |
| **Without fresh fruit & vege due to cost** | 0.6333 | t= 65.3077 | P>|t| = 0.0001 | 0.5012 |
| **Help (food clothing money) from community organisation** | 0.5298 | t= 49.8489 | P>|t| = 0.0001 | 0.4305 |
| **No access to internet at home** | 0.4985 | t= 45.8939 | P>|t| = 0.0001 | 0.3177 |
| **Difficulty paying for medical care for baby** | 0.4316 | t= 38.1880 | P>|t| = 0.0001 | 0.3418 |
| **Prescription for baby not affordable** | 0.4055 | t= 35.3980 | P>|t| = 0.0001 | 0.3170 |
| **Money problems a source of high stress** | 0.4814 | t= 43.8360 | P>|t| = 0.0001 | 0.3131 |

### Scale characteristics

Overall, the 10 item scale with the item ‘high stress from money problems’ performed marginally better than the other two scales, as indicated by the EFA, CFA and internal consistency results described above. Therefore, ten item scale with the item ‘high stress from money problems’ was used in all analyses described in sections 4 to 6.

#### Scale distributions of the number of items endorsed by respondents

The scale distributions for the three scales are detailed in Table 5. Approximately two-thirds of respondents in the ten item high stress scale (65.2%) and the nine item scale (68.7%) endorsed no or only one item (Table 5).[[27]](#footnote-27) Fewer (57.6%) in the respondents endorsed no or only one item in the ten item moderate or high stress scales. These scales discriminate among those with different levels of material hardship but do not discriminate across the spectrum of material wellbeing. This aligns with other scales such as NZiDep (Salmond & Crampton, 2012; Tobias & Mason, 2010) where 66 percent of the population endorse no material hardship items and the Dep17 index (Perry, 2016) where the scale discriminates well for the 20 to 30 percent of those in material hardship, but not for remaining 70 to 80 percent of the population.

At the higher end of the three material hardship scales, 8 percent of respondents endorsed five or more items for the 10 item high stress scale while 6.5 percent endorsed five or more items for the nine item scale. In the 10 item moderate to high stress scale, 9.2 percent of respondents endorsed five or more items (Table 5).

Table 5: Number of items endorsed for each of the scales

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Ten item scale: high stress money problems** | | **Ten item scale: moderate & high stress money problems** | | **Nine item scale** | |
| **Number of items endorsed** | **Frequency** | **Percent** | **Frequency** | **Percent** | **Frequency** | **Percent** |
| **0** | 2427 | 38.09 | 2101 | 32.98 | 2517 | 39.51 |
| **1** | 1728 | 27.12 | 1568 | 24.61 | 1858 | 29.16 |
| **2** | 892 | 14.00 | 1137 | 17.85 | 858 | 13.47 |
| **3** | 513 | 8.05 | 617 | 9.68 | 444 | 6.97 |
| **4** | 301 | 4.72 | 363 | 5.70 | 277 | 4.35 |
| **5** | 210 | 3.30 | 235 | 3.69 | 190 | 2.98 |
| **6** | 156 | 2.45 | 162 | 2.54 | 128 | 2.01 |
| **7** | 88 | 1.38 | 118 | 1.85 | 70 | 1.10 |
| **8** | 36 | 0.57 | 45 | 0.71 | 23 | 0.36 |
| **9** | 17 | 0.27 | 21 | 0.33 | 6 | 0.09 |
| **10** | 3 | 0.05 | 4 | 0.06 | **-** | **-** |
| **Total** | **6371** | **100.00** | **6371** | **100.00** | **6371** | **100.00** |

#### Item characteristics of the best performing hardship scale used for analyses

The item characteristic curves for the best performing 10 item hardship scale (Figure 3) shows the clustering of items at the middle and higher end of the hardship scale with very good discrimination for most items. Figure 4 shows the test information function for the scale and indicates how well different hardship levels are estimated by the scale. Again this confirms that the scale provides information about those with some and moderate levels of material hardship but does not provide information about (that is, differentiate among) those with no material hardship.

Figure 3: Item Characteristic Curves for 10 item hardship scale

Figure 3: Item Characteristic Curves for 10 item hardship scale

Figure 4: Test Information Function for 10 item scale

Figure 4: Test Information Function for 10 item scale

### Concurrent validity analysis suggests the best performing scale has validity

To test the concurrent validity of the scale, the mean scale score was obtained for several bivariate variables known to be associated with material hardship (eg Baker et al. 2013; Fisk et al. 2010; Keall et al. 2012). These variables were whether the:

* baby’s room had mould
* baby’s room had significant condensation
* number of people in the household per bedroom exceeded 2
* number of people in the household per bedroom exceeded 2.5
* house was damp
* baby’s mother did not have access to a car
* baby’s mother was a current smoker.[[28]](#footnote-28)

Figure 5 indicates that the mean score values were significantly different across all these variables in the expected direction. That is, poorer housing conditions, no access to a car, and smoking were significantly related to mean hardship score (p<0.0001 for all t-test results).

In addition, the mean score for each unadjusted[[29]](#footnote-29) household income category was calculated. The mean scale score across unadjusted household income categories was also significantly different and showed a linear relationship between household income and hardship scale score, with the mean hardship scale score decreasing as household income increased (Figure 6).

Overall, these results suggested that the scale had validity as it was strongly associated with a range of variables known to be associated with material hardship and it was negatively related to household income categories.

### Relationship of material hardship scale items with the Material Wellbeing Index (MWI) and MSD’s Deprivation Index (DEP-17)

MSD’s non-income measures of poverty that are used in reporting poverty levels in the New Zealand population include the MWI and DEP-17 (Perry, 2017). The 10 item material hardship scale items correspond reasonably well with the DEP-17’s 17 items and the hardship items in the MWI, although the DEP-17 and MWI have more items in them. The majority of the material hardship scale items used in this study relate to economising behaviours. However, there are individual items relating to financial strain, household heating, access to the internet, and a self-rating of money problems (financial strain). One item potentially relates to ownership or participation (access to internet at home) while another item about heating might fit with ‘housing problems’ but is also worded as an economising behaviour. No items relate to financial freedoms or restrictions.

Figure 5: Mean number of endorsed items on material hardship scale by concurrent variables with 95% confidence intervals

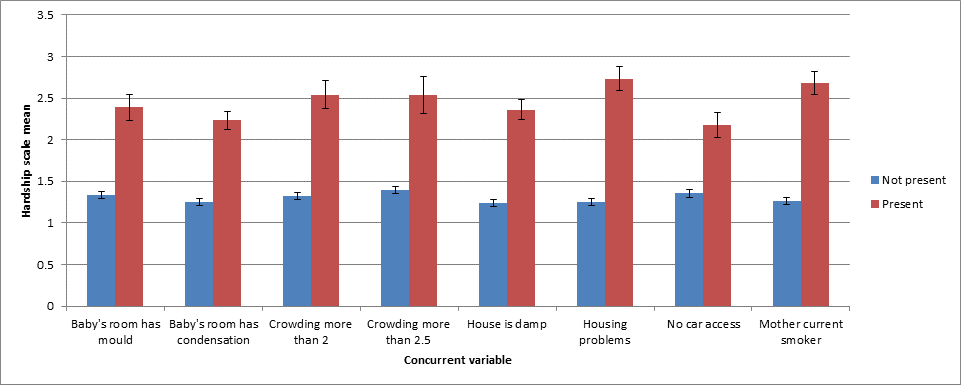
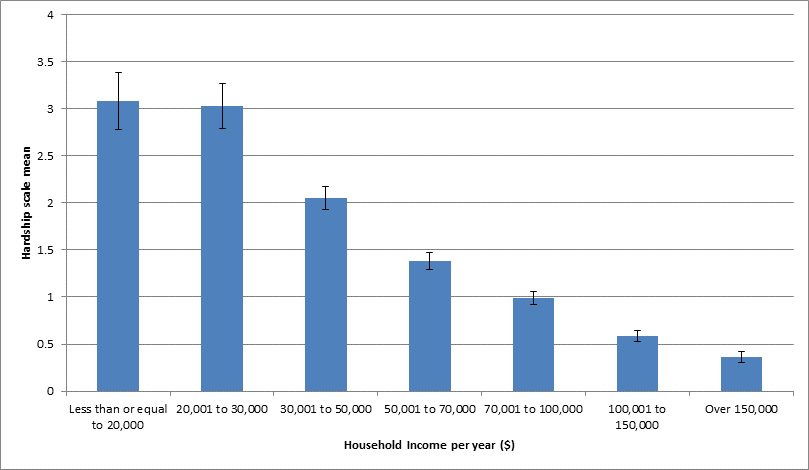


Figure 6: Mean number of endorsed items on material hardship scale by unadjusted Household Income Categoriesa with 95% confidence intervals



a Note: The household income categories have **not** been equivalised for number of adults and children within the household.

## Summary

This section described the development of a measure of material hardship scale that was used in the analysis as a proxy for exposure to different levels of poverty. It was derived from GUiNZ questionnaire items included in the mother’s nine-month interviews.

The following processes were used to develop and test the scale:

1. An examination of the difficulty and discriminatory contributions of test items, using IRT.
2. Exploratory factor analysis of three possible scales to determine whether the items in the scale loaded primarily onto the main factor, a test of the assumption of unidimensionality of the scale.
3. Confirmatory factor analysis to confirm the unidimensionality of the data and goodness of fit of the model taking into account covariance between items.
4. Estimates of index reliability/internal consistency, using Cronbach’s alpha and correlations between each item and the scale and each item and the rest of the scale items.
5. Concurrent validity testing using selected variables from within the data set which are known to be associated with material hardship.

Three possible scales were tested using different combinations of the best performing items identified in step 1. The best performing scale was identified from results in steps 2 to 4 (above). This scale was then re-tested within IRT analysis and for concurrent validity. The final set of items performed well or adequately as individual items and together as a scale on all the tests. Results indicated the scale measured low to higher levels of material hardship. That is, the scale discriminated different levels of material hardship and not the full spectrum of material wellbeing.

The 10 material hardship scale items were strongly associated with factors known to be associated with material hardship. The scale items corresponded reasonably well with those of the DEP-17 items and the material hardship items in the MWI.

The material hardship scale measured the extent of material hardship at a point in time. As the scale items were not included in the ante-natal data set, the duration of exposure to material hardship was not available for inclusion in this analysis. All children in the cohort were very young and a similar age. As the analysis is cross-sectional, the ‘age of exposure to material hardship’ was not relevant for this analysis but will be in future longitudinal analyses.

Overall, the scale met the requirements of a valid exposure measure for this research.

# Cohort characteristics

This section describes demographic and other respondent characteristics that were incorporated into the analyses described in sections 4 to 6. In the theoretical models derived from the literature, these factors operated as either potential confounders or mediators of the relationship between material hardship and the specified outcome. As noted in section 1 and described in Appendix One, the data linkage resulted in 6,371 observations in the data set and this data set was used in the following descriptive analyses.

## Measures of the mothers’ socio-demographic characteristics used in analyses

### Age group at time of recruitment

The age of mothers in the ante-natal data set ranged from 18 to 41 years. However, the actual age range was wider, as all mothers aged less than 18 years were re-categorised by GUiNZ data managers as 18 years of age. Similarly, all mothers aged over 41 years were re-categorised by GUiNZ data managers as 41 years of age.[[30]](#footnote-30) All mothers had an age recorded in the antenatal data set and this age is used in all the analyses in the report. It reflects the age of mothers’ prior to their child(ren)’s birth.

Over half of the mothers were aged 30 years or more (Table 6) as recorded in the ante-natal dataset. Less than 5% were aged below 20 years of age. Four categorisations of age were used in the analysis: 18 to 24 years; 25 to 29 years; 30 to 34 years and 35 years or more.

Table 6: Percentage of respondents by age group at ante-natal interview

|  |  |  |
| --- | --- | --- |
| **Age group of mother ante-natal data set** | **Frequency** | **Percent** |
|
| Under 20 years | 287 | 4.5 |
| 20 to 24 years | 892 | 14.0 |
| 25 to 29 years | 1554 | 24.4 |
| 30 to 34 years | 2005 | 31.5 |
| 35 years or more | 1633 | 25.6 |
| **Total** | 6371 | 100.0 |

### Two variables derived from ethnic identification questions were used in the analysis

Multiple ethnic identification categories were recorded for each respondent as well as a self-identified main ethnicity. Prioritised ethnic categorisations were derived from the data (Table 7) for analysis. The first prioritised ethnicity was based on researcher-imposed prioritisation hierarchy of Māori, Pacific peoples, Asian peoples and European or other peoples. This categorisation process led to a variable with one main ethnicity for each mother which was one of four different ethnicity categorisations. Seven mothers had a missing prioritised ethnicity.

The second prioritisation approach was available within the data set. It was a respondent-identified main ethnicity. The same four ethnicity categorisations were used to group respondents. This approach meant that 17 mothers had missing self-identified main-ethnicity.

These two variables were tested in the analyses. However, most of the analyses presented in the report were conducted with the prioritised ethnicity due to fewer missing values. Sensitivity testing was conducted using the self-identified main ethnicity for descriptive unadjusted associations and the final regression models. The inclusion of self-identified main ethnicity did not change the material hardship estimates significantly.

Table 7: Percentage of respondents by prioritised ethnicity and self-identified main ethnicity

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Prioritised ethnicity** | **Prioritised ethnicity** | | **Self-identified main ethnicity** | |
|  | **Frequency** | **Percent** | **Frequency** | **Percent** |
| Māori | 1134 | 17.8 | 849 | 13.4 |
| Pacific peoples | 891 | 14.0 | 872 | 13.7 |
| Asian peoples | 957 | 15.0 | 921 | 14.5 |
| European / Other | 3382 | 53.2 | 3712 | 58.4 |
| **Total** | 6364 | 100.0 | 6354 | 100.0 |

### Highest educational qualification data was used without modification

Highest educational level of mothers was included in the analysis (Table 8). This variable had 18 missing values and was used in the analyses without modification.

Table 8: Percentage of respondents by mother’s highest educational qualification

|  |  |  |
| --- | --- | --- |
| **Mother’s highest educational qualification** | **Frequency** | **Percent** |
|
| No secondary school qualification | 417 | 6.6 |
| NCEA level 1-4 | 1481 | 23.3 |
| Diploma/Trade cert/NCEA 5-6 | 1957 | 30.8 |
| Bachelor's degree | 1474 | 23.2 |
| Higher degree | 1024 | 16.1 |
| **Total** | 6353 | 100.0 |

Missing =18

## Mother’s relationship characteristics were also included in some of the regression analyses

Several relationship characteristics were included in the research as these have been associated with maternal and/or child outcomes. These are described below for the 6,371 respondents included in the analyses.

### Nine out of ten mothers had a partner when interviewed (nine-month interview) – relationship status

At the time of the nine-month interview, each of the respondents was asked whether they currently had a partner. Overall, 10.7% of mothers stated that they did not have a partner at the time of the interview. This binary variable was included in the analyses without modification. It is referred to as ‘relationship status’ in figures.

### Perceived level of social support at nine months was measured in two ways

Twelve items from the Family Support Scale (Dunst, Trivette, & Hamby, 1994) were included in the mothers’ nine-month interview. The items included family and professional (or other) support items.

#### Six social support items related to helpfulness of support from family and formed a sub-scale

Six items asked respondents about how helpful they found their partner, their parents, their partner’s parents, their extended family (eg cousins, brothers and sisters, grandparents), their partner’s extended family, and their friends. The response options included ‘not available’, ‘not at all helpful’, ‘sometimes helpful’, ‘generally helpful,’ ‘very helpful’ and ‘extremely helpful’. All items with a non-response were coded as not available. For five items, non-responses ranged from 2 to 7 out of 6,371 observations, apart from one item which had 12 non-responses. The scale total, therefore, has a non-response of less than one percent. The scale total score range was 0 to 30.

The six item scale was tested using Cronbach’s alpha for internal consistency and exploratory factor analysis and confirmatory factor analysis for assessing whether the items had a single underlying factor. Tests of the six item scale resulted in a Cronbach’s alpha of 0.68. EFA indicated that the unrotated Eigenvalue on the first factor was 1.65 compared with 0.34 for the second factor. CFA goodness of fit tests indicated a RMSEA of 0.034, a CFI of 0.991 and a TLI of 0.983, once co-variances were taken into account.

#### Six social support items related to helpfulness of support from other sources but did not form a viable sub-scale

Respondents were also asked how helpful they found other sources of support including their family doctor, professionals (such as Plunket nurse, well child nurse, and kaiawhina), early childhood carers (daycare centre, Kohanga Reo and home-based programme), early parenting support programmes (such as Parents as First Teachers), books, and the internet. Overall, these items had higher levels of missing values compared with items relating to support from family members. Two items had 177 and 204 missing values (approximately 3% for each item), while the remaining four had between 15 and 37 missing values (less than 1% for each item).

Testing indicated that these items did not form a viable scale by themselves as internal consistency was relatively low (Cronbach’s alpha of 0.52) and EFA results indicated that not all items loaded onto the first factor. Therefore, these items were not used as a separate scale but several items were tested in a combined support scale with the family support scale items.

#### A combined social support scale was developed using eight of the original twelve items

The two sets of items were combined and tested. A combination of eight items remained after removing items with low ‘item-test’ and low ‘item-rest of items’ correlations.

The set of items with the highest Cronbach’s alpha (0.69) included all the family support items and two other support items (family doctor and professionals such as nurses and kaiawhina). For the eight item scale, the unrotated Eigenvalue on the first factor was 1.86 compared with 0.53 for the second factor. Confirmatory factor analysis goodness of fit tests indicated a root mean squared error of approximation 0.043 (0.037-0.051), a comparative fit index of 0.988 and a Tucker-Lewis index of 0.961, once co-variances were taken into account. This new scale had scores ranging from 0 to 40 with a slightly negatively skewed distribution.

#### The family support sub-scale and the combined social support scale were used in analyses

The six item “family support’ scale (range 0 to 30) and the eight item ‘family and professional support’ scale (range 0 to 40) showed similar levels of consistency, item performance and factor analyses results. Therefore, both scales were tested and used in the analyses.

The scale scores were used as continuous variables to calculate means for determining whether there was an unadjusted association with categorical outcomes. For the descriptive unadjusted associations with material hardship and for regression analyses, the scores were grouped into four categories. Of particular interest for the analysis were those with low levels of support and those with high levels of support. Therefore an arbitrary cut-off was made so that the lowest and highest of the four categories each comprised approximately 14 percent of the population.

### Relationship quality

#### Two proxy scales for relationship quality were tested

Two scales drawn from the GUiNZ data were tested as proxies for relationship quality. They were the Verbal Conflict scale and the Warmth and Hostility scale.

Only the total score for each scale was provided in the data set, so an analysis of the scale performance for this group of respondents could not be conducted. In the data set, scores for the Verbal Conflict scale ranged from 3 to 21, while the scores for the Warmth and Hostility scale ranged from 15 to 63.

Based on the literature, relationship quality was associated with several of the outcomes analysed for this research. However, in the literature, relationship quality was considered a potential mediator for the outcomes of interest, rather than a potential confounder. Therefore, relationship quality was not included in the final models estimating the total level of association of material hardship with the outcome.

## Children’s characteristics

Most of the child-related data included in the analysis are about children’s outcomes, rather than their characteristics. Child outcomes were analysed in relation to the social and physical environments of the child, particularly with respect to the mother’s characteristics and her socio-economic circumstances. Gender of the child was tested in the analysis.

### Age of child at time of nine-month interview

The analysis was conducted for data collected when the children were approximately nine months of age, with most (96%) aged between 7 and 12 months when their mothers were interviewed. This variable was not included in the analyses, except for testing whether the inclusion of age in the final model for the number of child respiratory conditions/ear infections affected the estimates for material hardship. Age at interview may have been a potential confounder.

### Parity of child

The pregnancy was the mother’s first child for about two-fifths (42%) of mothers included in the analysis. This variable was tested in the regression analyses of the relationship of material hardship with maternal depression and anxiety. The unadjusted variable was associated with material hardship but t-tests were not strongly associated with anxiety and depression. Testing in the final model indicated that this variable did not change the odds ratios for material hardship; was not independently related to a moderate/high probability of maternal depression and the likelihood of moderate to severe anxiety; and did not improve model fit statistics. Therefore, parity of the child is not described further in this report.

### Children’s gender

Just over half (3,295, 51.72%) of the children included in the analyses were male and 48.28% (3,076) were female. This variable was included in selected analyses without modification.

## Summary

Demographic and relationship factors for GUiNZ mothers and their children were described in this section.

A total of 6,371 respondents remained in the data set after data linkage. As the analysis incorporated many maternal characteristics and outcomes, it was important to ensure that the data related to the same mother/caregiver. Therefore only those mothers whose identification number matched across the id, antenatal, six weeks and nine-month data sets were retained. In cases of twins or triplets, information from only one of the children was included in the linkage. Overall, data for 94% (6,371) of the children in the cohort (6,753, when counting only one child from families with multiple births) and their mothers were included in the analysis.

Several demographic and relationship factors were incorporated in regression analyses as potential confounding factors because they were associated with material hardship and outcomes in the analyses. They are described in sections 4 to 6.

# Association of material hardship with maternal depression and anxiety

## Background

This section describes the analysis and results for estimating the total degree of association of material hardship with two maternal outcomes: moderate or high probability of depression and moderate to severe anxiety. The analysis used cross-sectional data from the GUiNZ maternal interviews when their child was approximately nine months old. As the estimates are derived from cross-sectional data they measure association only.

It was hypothesised that material hardship influences the likelihood of mothers experiencing depression and anxiety directly and, indirectly, through relationship quality. A range of evidence supports this hypothesis (eg Conger et al., 2010; Dominick, 2018; Gershoff et al., 2007; Hanington et al., 2012; Howard et al., 2014; Kiernan & Huerta, 2008; Kiernan & Mensah, 2009; Melchior et al., 2012). However, the extent of the association, once potential confounding is taken into account, is uncertain within the New Zealand context.

Maternal depression can influence parenting interactions, practices and a mother’s attachment with her child, which in turn affects a child’s socio-emotional and cognitive development (eg Hanington et al., 2012).

## Methods

The methods used for the analysis broadly followed the phases of analysis described in section 1 specifically the approach described by Greenland & Pearce (2015) and Greenland et al. (2016). The purpose was to estimate the ‘total’ level of the association between material hardship and maternal depression or maternal anxiety.

First, the hypothesised relationships between material hardship and several factors potentially confounding the relationship were identified from previous studies described in the literature. These are illustrated in a directed acyclic graph (DAG) (Figure 7). In addition, as noted above relationship quality was included in the DAG as a potential mediator of the relationship between material hardship and maternal depression and anxiety.

After ascertaining from the literature which factors were potential confounders, the next step was to test whether these factors met the conditions for potential confounding in the dataset. That is, whether the potential confounders were: associated with material hardship (exposure) as indicated by data analysis; associated with maternal outcomes (maternal depression and anxiety) as indicated by data analysis; and **not** on the causal pathway between material hardship and maternal outcomes as indicated by the literature. If factors met these three conditions, they were included as potential confounders in the final model that estimated the ‘total effect’ (association) between material hardship and maternal depression or anxiety.

Variables that were identified as potential mediators were excluded from the final model estimating the total effect, as mediating pathways form part of the total effect (through an indirect pathway).

The relationships outlined in the DAG informed the conduct of a stepwise logistic regression analysis. Demographic characteristics likely to be confounders of the relationship between material hardship with maternal depression or anxiety were introduced first followed by other potential confounders. At each stage, model statistics were generated using the ‘fitstat’ command in STATA 14/15 to assess the contribution of the factor to the model.[[31]](#footnote-31) In addition, goodness of fit tests were applied to the final models (Hosmer-Lemeshow and Pearson as appropriate).

The models were designed to estimate the total degree of association between material hardship and either maternal depression or maternal anxiety. Therefore, only these estimates are detailed in the body of the report. The full model results that include covariates’ odds ratios or beta estimates are detailed in Appendix 4. It should be noted that the covariates’ levels of association within the final model may not provide an accurate level of association with the outcome, as the model was designed to assess the total level of association of material hardship with maternal outcomes not the covariates. New models would need to be developed to estimate the level of association for specific covariates, that is, the covariate of interest would need to be treated as an exposure which, in turn, may mean that a range of other potential confounders and mediators would be included in the model.

## Hypothesised relationships of material hardship with maternal outcomes and related confounding and mediating factors

The hypothesised relationships between material hardship, maternal anxiety or depression and potential confounding and mediating factors are illustrated in Figure 7, a DAG of the relationships. These are hypothesised causal relationships based on information drawn from the literature (eg Conger et al., 2010; Dominick, 2018; Gershoff et al., 2007; Hanington et al., 2012; Howard et al., 2014; Kiernan & Huerta, 2008; Kiernan & Mensah, 2009; Melchior et al., 2012). These hypothesised relationships provide a framework for an analysis of causal effects. However, the analysis in this study is cross-sectional rather than longitudinal; therefore the direction of effect and whether it is causal cannot be tested.

Potential confounding factors included in the DAG are a mother’s age, ethnicity, highest educational qualification and relationship status. Population level evidence indicates there is an association between these factors and ‘material hardship’ (Ministry of Social Development, 2016; Perry, 2016) and with the prevalence of depression and anxiety (Ministry of Health, 2016) in the New Zealand general population. Levels and types of social support are also associated with material hardship and depression (Harknett, 2006; Henly, Danziger, & Offer, 2005; Kang, 2013; Lee & Lee, 2016) and were, therefore, included in the analysis.

‘Relationship quality’ was hypothesised as a potential mediator between material hardship and maternal anxiety or depression (eg Dominick, 2018; Gershoff et al., 2007; Hanington et al., 2012; Kiernan & Huerta, 2008; Kiernan & Mensah, 2009). Therefore, it was **not** included in the model estimating the ‘total’ association between exposure and outcome. If relationship quality is operating as a mediator, then the effect, through this indirect pathway, would be included in the estimate of the total level of association.

Figure 7: Hypothesised pathwaysa between material hardship and maternal anxiety and depression with associated potential confoundersb and mediatorc

Figure 7: Hypothesised pathwaysa between material hardship and maternal anxiety and depression with associated potential confoundersb and mediatorc

a The main relationship that is assessed in the analysis is depicted by the red arrow, the total level of association between material hardship and the outcome.

b Potential confounding factors are not on the causal pathway between the exposure (material hardship) and the outcome (for the relationship examined in this research), but they may bias the estimate if not taken into account in the analysis. The hypothesised direction of influence of the potential confounding factors is depicted by a blue arrow drawn from the confounder to the factor it is associated with.

c Mediating factors are potentially intermediary factors that sit along a causal pathway between the exposure (material hardship) and the outcome. They represent an indirect pathway between the exposure and the outcome. The hypothesised direction of influence of the mediator is depicted with a green arrow from the exposure (material hardship) to the mediating factor and then to the outcome.

## Exposure and outcome measures

### Exposure: Material hardship

The material hardship measure used in the analysis was described in section 2. It was used as a continuous variable in calculating means in initial descriptive analyses. Categories were developed for use in logistic regression analyses given the non-normal distribution of values in the scale. The categories were based on the number of material hardship items endorsed by respondents (refer to Table 5, section 2) and comprised four groups:

* no hardship items (38.1%)
* one hardship item (27.1%)
* two or three hardship items (22.1%)
* four or more hardship items (12.7%).

The reference category used in all logistic regression analyses was no material hardship items.

### Maternal Outcomes: moderate or high probability of depression and moderate to severe anxiety

**Maternal depression** was measured using the Edinburgh Postnatal Depression Scale (EPDS) (Cox, 2017; Cox, Holden, & Sagovsky, 1987; Cox, Chapman, Murray, & Jones, 1996; Gibson, McKenzie-McHarg, Shakespeare, Price, & Gray, 2009) which is a self-report screening tool used in general populations. In validating the tool for women in the postnatal period, Cox et al. (1987) noted that their data suggested the women who scored above a threshold of 12/13 were most likely to be suffering a depressive illness. The scale has also been validated for women with older children and use in these populations is referred to as the Edinburgh Depression Scale (EDS) (Cox et al., 1996).

Cut-off scores for the EPDS cited in the literature vary.[[32]](#footnote-32) Scores of 13 or more, and scores of 12 or more, have been used to indicate moderate or high probability of post-partum depression (PPD) or depression (for women with older children). Both the 12+ and 13+ cut-off scores were tested in the analysis. For the 13+ cut-off, approximately three quarters (77.4%) of respondents had no or low probability of depression while approximately one in 12 (8.1%) respondents had a moderate or high probability of depression (Table 9).[[33]](#footnote-33) For the 12+ cut-off, approximately 10.7% of respondents had a moderate or high probability of depression (Table 10).

Logistic regression results described in the body of the report are for the 12+ cut-off. Material hardship odds ratio results in models using the 13+ cut-off are very close to those obtained for the 12+ cut-off (refer to Appendix 4).

Table 9: Percentage of respondents by Edinburgh Postnatal Depression Scale (EPDS) categories (13+ cut-off)

|  |  |  |
| --- | --- | --- |
| **Edinburgh Postnatal Depression Scale categories** | **Frequency** | **Percent** |
|
| **No or low probability of depression (score: 0-8)** | 4919 | 77.4 |
| **Feeling low (score: 9-12)** | 922 | 14.5 |
| **Moderate probability of depression (score: 13-14)** | 222 | 3.5 |
| **High probability of depression (score: 15+)** | 291 | 4.6 |
| **Total** | 6354 | 100.0 |

Missing data =17. Note if any item responses were missing then the scale score was missing.

Table 10: Percentage of respondents by Edinburgh Postnatal Depression Scale (EPDS) categories (12+ cut-off)

|  |  |  |
| --- | --- | --- |
| **Edinburgh Postnatal Depression Scale categories** | **Frequency** | **Percent** |
|
| **No or low probability of depression (score: 0-8)** | 4920 | 77.4 |
| **Feeling low (score: 9-11)** | 753 | 11.9 |
| **Moderate probability of depression (score: 12-14)** | 390 | 6.1 |
| **High probability of depression (score: 15+)** | 291 | 4.6 |
| **Total** | 6354 | 100.0 |

Missing data =17. Note if any item responses were missing then the scale score was missing.

**Maternal anxiety** was measured using the Generalised Anxiety Disorder (GAD-7) scale which is used as a screening tool for anxiety conditions in general populations. Scores of 10 or more on this scale indicate that respondents are likely to have moderate to severe anxiety (Spitzer, Kroenke, Williams, & Löwe, 2006; Williams, 2014).

The recommended cut-off point when screening for an anxiety disorder is 10 or more (Williams, 2014). Using this cut-off, results indicated that slightly less than three-quarters of mothers (71.0%) had no or low probability of anxiety, around a fifth (21%) had mild anxiety, while approximately one in 13 (7.7%) respondents were likely to have moderate to severe anxiety (Table 11).

Table 11: Percentage of respondents by Generalised Anxiety Disorder (GAD-7) categories

|  |  |  |
| --- | --- | --- |
| **Generalised Anxiety Disorder (GAD-7) categories** | **Frequency** | **Percent** |
|
| **No or low probability of anxiety (score: 0-4)** | 4509 | 71.0 |
| **Mild anxiety (score: 5-9)** | 1354 | 21.3 |
| **Moderate anxiety (score: 10-14)** | 367 | 5.8 |
| **Severe anxiety (score: 15+)** | 122 | 1.9 |
| **Total** | 6352 | 100.0 |

Missing data =19

Overall, at the nine-month interview, a total of 13.6% of respondents were likely to have anxiety or depression while an additional 4.8% were likely to have both anxiety and depression.

The EPDS/EDS and GAD-7 scores were categorised into separate binary variables because of the non-normal score distributions and because the scales were designed as screening tools for depression and generalised anxiety respectively. For the EPDS/EDS, the categories differentiated respondents who had a moderate or high probability of depression from those respondents who did not. For the GAD-7, the categories differentiated respondents who were likely to have moderate to severe anxiety from those respondents who were likely to have mild or no anxiety.

## Results – unadjusted associations

### Material hardship showed a strong unadjusted association with maternal depression and anxiety

Material hardship was strongly associated with moderate/high probability of depression and moderate to severe anxiety, as indicated by mean hardship scale scores and unadjusted odds ratios (Table 12 and Table 13).

The mean hardship scale score for those with moderate/high probability of depression was 2.67 (CI: 2.5-2.84) compared with 1.32 (95% CI: 1.28-1.36) (p<0.0001) for those who did not have moderate/high probability of depression. The mean hardship scale score for those likely to have moderate to severe anxiety was 2.77 (95% CI: 2.56-2.98) compared with 1.35 (95% CI: 1.31-1.4) (p<0.0001) for those with who did not have moderate to severe anxiety.

The unadjusted odds ratios for both moderate/high probability of depression and moderate to severe anxiety indicate an increasing trend across the three material hardship groups (Table 12 and Table 13). Tests of trend indicate significant differences between the three groups (p<0.0001). This indicates that as the level of material hardship increases the likelihood of depression or anxiety increases. However, these are unadjusted results and have not taken into account potential confounders which may have distorted the obtained estimates.

Table 12: Unadjusted odds of moderate or high probability of depression by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Unadjusted Odds Ratio** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.81 | 0.229928 | 4.68 | 0.000 | 1.41 | 2.32 |
| Two or three vs No items | 3.05 | 0.370500 | 9.15 | 0.000 | 2.40 | 3.99 |
| Four or more vs No items | 7.14 | 0.875184 | 16.05 | 0.000 | 5.62 | 9.08 |

Table 13: Unadjusted odds of moderate to severe anxiety by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Unadjusted Odds Ratio** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.71 | 0.259571 | 3.55 | 0.000 | 1.27 | 2.31 |
| Two or three vs No items | 3.02 | 0.431102 | 7.73 | 0.000 | 2.28 | 3.99 |
| Four or more vs No items | 7.29 | 1.026771 | 14.10 | 0.000 | 5.53 | 9.61 |

### All potential confounding factors met the conditions for potential confounding

Potential confounders of the relationship between the exposure (material hardship) and the outcomes (maternal anxiety or depression) had associations with material hardship and maternal anxiety and depression in the expected directions. In summary:

* Age group of mothers was:
  + negatively associated with material hardship: that is younger age groups were associated with higher material hardship (Figure 8)
  + negatively associated with maternal depression and anxiety: that is, younger age groups had a higher probability of depression and anxiety (refer to Appendix 3 for details).
* Ethnicity of mothers showed significant variation as:
  + Māori and Pacific peoples, on average, had higher material hardship scores than Asian peoples or European/Other groups (for both prioritised and self-identified main ethnicity). On average, Pacific peoples had higher scores than Māori (Figure 9)
  + a greater percentage of Pacific, Māori, and Asian mothers compared with European/Other mothers had a moderate or high probability of depression (Appendix 3)
  + a greater percentage of Māori and Pacific mothers were likely to have moderate to severe anxiety compared with European/Other and Asian mothers (Appendix 3).
* Highest educational qualification of mothers was:
  + negatively associated with material hardship: that is, higher educational qualifications were associated with lower material hardship (Figure 10)
  + negatively associated with EPDS scores and with GAD-7 scores. That is, as highest educational qualification increased, the percentage of respondents with a moderate or high probability of depression or anxiety decreased. (Appendix 3).
* Mothers without a partner at the time of the interview were:
  + more likely to be in material hardship. (Mean material hardship score 2.7: 95% CI 2.6-2.9 compared with 1.3: 95% CI 1.3-1.4; p<0.0001)
  + more likely to have depression or anxiety (refer to Appendix 3).
* Low levels of perceived social support (family support or family and professional support) were:
  + associated with greater likelihood of material hardship (Figure 11)
  + associated with greater likelihood of depression or anxiety (Appendix 3).

Figure 8: Mean material hardship score by mother’s age group

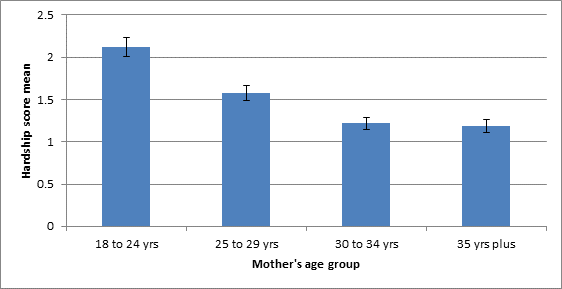


Figure 9: Mean material hardship score by mother’s ethnicity (prioritised and self- identified)

Figure 9: Mean material hardship score by mother’s ethnicity (prioritised and self- identified) 

Figure 10: Mean material hardship score by mother’s highest educational qualification

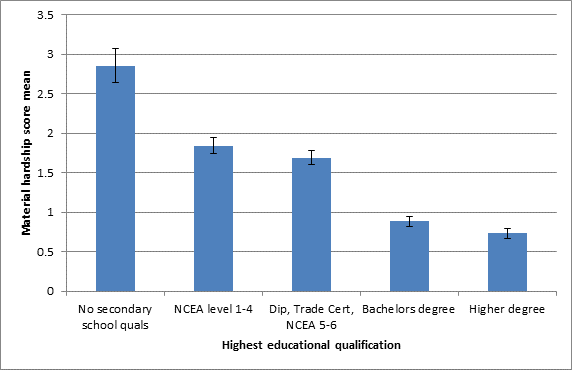
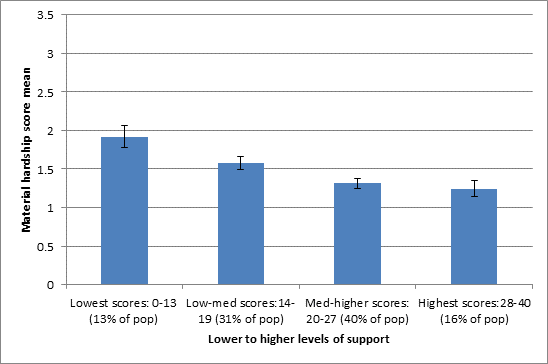


Figure 11: Mean material hardship score by levels of family and professional support



## Results –adjusted associations

### Material hardship remained strongly associated with maternal depression after adjusting for potential confounding

Material hardship remained significantly and positively associated with maternal depression, after confounders were included in the model. That is, mothers with higher levels of material hardship had higher odds of having a moderate or high probability of depression (Table 14 and Table 15).

After adjusting for confounders (including level of family support), mother’s with four or more material hardship items had odds of depression 5 times the odds of mothers with no material deprivation items. Mothers with two or three material hardship items had odds of depression 2.6 times the odds of mothers with no hardship items. Similarly, mothers with one hardship item had odds of depression 1.7 times the odds of mothers with no items. Tests of trend between levels ‘One item’ and ‘Two or three items’ and between ‘Two or three items’ and ‘Four or more items’ were significant (p<0.001 and p<0.0001 respectively), indicating that the odds of depression for each level of material hardship was significantly higher than the next lower level of hardship.

Table 14: Adjusted odds of moderate/high probability of depression by material hardship groupsc

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.67 | .22 | 3.97 | 0.000 | 1.30 | 2.15 |
| Two or three vs No items | 2.56 | .33 | 7.40 | 0.000 | 2.00 | 3.29 |
| Four or more vs No items | 4.96 | .68 | 11.59 | 0.000 | 3.78 | 6.50 |

a Adjusted for mother’s age, ethnicity, and highest educational level; level of family support; and whether the mother had a current partner.

b Crude conversion of the odds ratio into a risk ratio: 1.62, 2.38 and 4.15 (refer to Appendix 4 for the formula used in the conversion). The base rate of depression in the unexposed population with, no material hardship items, is 4.96%.

c This model used the family support variable.

Including family and professional support rather than family support in the model as a confounder, did not reduce the association between material hardship and depression (Table 15). A trend analysis for this model also indicated that the odds ratios for each level of material hardship were significantly different (p<0.001 and p<0.0001) from each other.

Table 15: Adjusted odds of moderate/high probability of depression by material hardship groups (including family and professional support variable)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.68 | .22 | 4.02 | 0.000 | 1.30 | 2.17 |
| Two or three vs No items | 2.55 | .32 | 7.36 | 0.000 | 1.99 | 3.27 |
| Four or more vs No items | 5.00 | .69 | 11.65 | 0.000 | 3.81 | 6.55 |

a Adjusted for mother’s age, ethnicity, and highest educational level; level of family and professional support; and whether the mother had a current partner.

b Crude conversion of the odds ratio into a risk ratio: 1.63, 2.39 and 4.17. The base rate of depression, in the unexposed population with no material hardship items, is 4.96%.

### Material hardship remained strongly associated with maternal anxiety after adjusting for potential confounding

Material hardship was significantly and positively associated with moderate to severe anxiety after confounding factors were taken into account (Table 16 and Table 17). That is, as the level of material hardship increased the odds of moderate to severe maternal anxiety increased. After adjusting for covariates (including family support), mother’s with four or more material hardship items had odds of having anxiety 5.4 times the odds of mothers with no material hardship items. Mothers with two or three items had odds of having anxiety 2.6 times the odds of mothers with no material hardship items. Mothers with one hardship item also had odds of anxiety 1.6 times the odds of mothers with no hardship items.

Table 16: Adjusted odds of moderate to severe anxiety by material hardship groupsc

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Odds Ratioa,b** | **Std. Error** | **z value** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.61 | .25 | 3.09 | 0.002 | 1.19 | 2.17 |
| Two or three vs No items | 2.62 | .39 | 6.50 | 0.000 | 1.96 | 3.51 |
| Four or more vs No items | 5.44 | .86 | 10.69 | 0.000 | 3.99 | 7.43 |

a Adjusted for mother’s age, education, ethnicity, and highest educational level; level of family support; and whether the mother had a current partner.

b Crude conversion of the odds ratio into a risk ratio: 1.58, 2.48 and 4.71. The base rate of anxiety, in the unexposed population with no material hardship items, is 3.47%.

c This model used the family support variable.

The odds estimate did not shift significantly when the variable including family and professional support were included in the model (Table 17). After adjusting for covariates (including family support and professional support), mother’s with four or more material hardship items had odds of moderate to severe anxiety 5.5 times the odds of mothers with no material hardship items. Mothers with two or three items had odds of having moderate to severe anxiety 2.6 times the odds of mothers with no material hardship items. Mothers with one hardship item also had odds of moderate to severe anxiety 1.6 times the odds of mothers with no hardship items.

Table 17: Adjusted odds of moderate to severe anxiety by material hardship groups (including family and professional support variable)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Odds Ratioa,b** | **Std. Error** | **z value** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.61 | .25 | 3.13 | 0.002 | 1.20 | 2.18 |
| Two or three vs No items | 2.62 | .39 | 6.48 | 0.000 | 1.96 | 3.50 |
| Four or more vs No items | 5.49 | .87 | 10.73 | 0.000 | 4.02 | 7.48 |

a Adjusted for mother’s age, education, ethnicity, and highest educational level; level of family and professional support; and whether the mother had a current partner.

b Crude conversion of the odds ratio into a risk ratio: 1.58, 2.48 and 4.75. The base rate of anxiety in the unexposed population (no material hardship items) is 3.47%.

A test of trend indicated that there were statistically significant differences between levels of material hardship (p<0.001 and P<0.0001) for odds outlined in both Tables 16 and 17.

### Material hardship remained associated with maternal depression and anxiety taking into account maternal substance use

In the review process, it was suggested that maternal substance use may be an important omitted confounder affecting the validity of the results. Although not part of the original analysis, a test of the final models was conducted by including variables relating to alcohol use (‘average number of servings of alcohol per week’, a four level categorised variable), marijuana (use ‘marijuana use since the baby’s birth’, a dichotomous variable), and other drugs (‘use of amphetamines, cocaine, ecstasy, opiates, hallucinogens and party pills since the baby’s birth’, a dichotomous variable).

Adding the potential confounder of current ‘average number of servings of alcohol per week’ to the final models for maternal depression (Table 15) did not change the odds ratios significantly. The odds ratios of material hardship were 1.69, 2.56, and 4.97 which are very close to those in Table 15. Similarly, adding the potential confounder to the final model for maternal anxiety did not change the maternal hardship odds significantly. The odds ratios of material hardship were 1.62, 2.63, and 5.45 (cf Table 17).

Including the potential confounder for ‘use of marijuana since the baby’s birth’ in the final model for maternal depression did not change the odds ratios for material hardship significantly. With this confounder added, the odds ratios of material hardship were 1.67, 2.54 and 4.87, which are very similar to those detailed in Table 15. Similarly, adding the potential confounder to the final model for maternal anxiety did not change the material hardship odds significantly. The odds of material hardship were 1.59, 2.59, and 5.29 (cf Table 17).

Including the potential confounder of ‘use of amphetamines, cocaine, ecstasy, opiates, hallucinogens and party pills since the baby’s birth’ in the final model for maternal depression did not change the odds ratios for material hardship significantly. With this potential confounder added, odds ratios for material hardship were 1.68, 2.55 and 5.0 (cf Table 15). As found previously, adding this potential confounder to the final model for maternal anxiety did not change the material hardship odds significantly. The odds of material hardship were 1.62, 2.62, and 5.49 (cf Table 17).

## Summary

The hypothesised relationships between material hardship and maternal depression or anxiety alongside potential confounders and a potential mediator were outlined in a DAG, informed by the international and national literature. Material hardship, maternal depression or anxiety, and potential confounders were included in the final model (but not potential mediators) as the aim was to estimate the total level of association between exposure and outcome.

Results indicated that at approximately nine months after the birth of their baby, mothers experiencing material hardship were more likely to have a moderate/high probability of depression compared with those without material hardship. Similarly, mothers experiencing material hardship were more likely to have moderate to severe anxiety compared with those without material hardship.

The level of association of material hardship with depression and anxiety increased as material hardship increased. In addition, the trend analysis was significant indicating a positive ‘dose-response’ relationship where, the odds at each level of material hardship were significantly different from the next lower level of hardship. That is, those with greater material hardship were significantly more likely to have anxiety or depression compared with those with lower levels of material hardship.

The level of the association with depression, for mothers with four or more hardship items, was relatively high; with an odds ratio of 5.0 compared with mothers with no material hardship items, after adjusting for confounding factors. That is, the odds of depression for those with four or more material hardship items were five times the odds of mothers’ with no material hardship items. Converting the odds ratio into a risk ratio indicates a risk of approximately 4.2 times the risk of those with no material hardship items.

Similarly, the level of association with anxiety for the group with four or more hardship items was high with an odds ratio of 5.5 in relation to mothers with no material hardship items, after adjusting for confounding factors (including family and professional support). That is, the odds of anxiety for mothers’ with four or more material hardship items were five and half times the odds for those mothers’ with no material hardship items. Converting the odds ratio into a risk ratio indicates a risk of approximately 4.8 times the risk of those with no material hardship items.

These findings are consistent with a range of other evidence (eg Baer et al., 2012; Howard et al., 2014; Kiernan & Huerta, 2008; Kiernan & Mensah, 2009; Mazza et al., 2016; Petterson & Albers, 2001) indicating that material hardship is associated with greater risk of maternal depression and anxiety.

# Association of material hardship with infant temperament outcomes

The analysis described in this section was designed to estimate the association of material hardship with infant temperament outcomes. The influence of temperament on a child’s developmental pathways and outcomes across a range of areas has been recognised, including outcomes previously considered primarily the result of socialisation such as conduct problems, empathy and the development of conscience (Rothbart, 2012).

“Temperament refers to individual differences in the infant and young child that exist before many of the more cognitive aspects of personality have developed. Temperament includes variability in positive affect and approach, fear, frustration, sadness and discomfort, as well as attentional reactivity and self-regulatory controls on behaviour, thought and emotion. Temperamental dispositions, which are reflected in orientations toward or away from objects, people and events, are critical to the development of coping and meaning structures, competence and motivation.” (Rothbart 2012, p.1)

By nine months of age, an infant’s social environment has already started to shape temperamental dispositions. For example, research has shown that by 3 to 6 months of age, inter-parental interactions have influenced an infant’s behavioural and physiological reactions (eg Harold et al., 2016; Miller, 2015).

### The ‘Infant Behavior Questionnaire Revised Very Short Form’ provided the scales for an analysis of temperament

Three infant temperament outcomes were considered in the analysis. The infant temperament outcomes were obtained from results of the Infant Behavior Questionnaire Revised Very Short Form (IBQR-VSF) (Garstein & Rothbart, 2003; Putnam, Helbig, Gartstein, Rothbart, & Leerkes, 2014).

The IBQR-VSF includes three separate dimensions:

* ‘Surgency’, which relates to positive emotionality and extraversion
* ‘Negative Affect’, which relates to negative emotionality
* ‘Effortful Control’ which is an early temperamental marker of regulation-related processes, shown to be related to later effortful control (consciously focusing and shifting attention, inhibiting or activating a response as a situation requires and the capacity for enjoyment of low-intensity activities) (Gartstein et al., 2012).

These factors provide a basis for social-emotional development and the development of internalising or externalising problems. Gartstein et al. (2012) noted that externalising problems include under-controlled acting out behaviours (for example, conduct difficulties, hyperactivity and impulsivity). In contrast, internalising problems involve inward-directed reactions and experiences of distress (for example, sadness, depression, worry or anxiety).

Research suggests that that high infant ‘Negative Affect’ scores are linked with both internalising and externalising problems later in a child’s development (Gartstein et al., 2012). Although ‘Effortful Control’ and ‘Surgency’ on their own were not found to be associated with internalising and externalising problems, interactions between negative affectivity and high or low ‘Surgency’ scores and ‘Negative Affect’ and low ‘Effortful Control’ scores were associated with problems later in childhood (Gartstein et al., 2012). These interactions were not assessed in this analysis as they are more appropriate for longitudinal analyses.

As a first step, the analysis aimed to assess the total level of association between material hardship and individual infant temperament outcomes when the child was approximately nine months of age.

## Methods used to assess the association between material hardship and infant temperament outcomes

The analytic approach used for this analysis paralleled the approach used in assessing the association between material hardship and maternal depression/anxiety (section 4). The steps involved:

* delineating the hypothesised pathways between material hardship and child temperament outcomes
* identifying whether there were unadjusted associations between material hardship and child temperament, potential confounders and potential mediators
* identifying whether there were unadjusted associations between potential confounders and child temperament
* conducting step-wise logistic regression with potential confounding factors included in the initial analysis to obtain the total effect estimate
* testing the sensitivity of the cut-off points
* the addition of potential mediating factors to test the strength of the association.

The association was also tested using a linear regression model.

### Hypothesised relationship of material hardship with infant temperament outcomes

The hypothesised relationships of material hardship with infant temperament outcomes are outlined in Figure 12. These hypothesised relationships were informed by a range of studies in the literature (eg Cooper & Stewart, 2013; Dominick, 2018; Mayer, 2002; Gershoff et al., 2007).

The two main models considering the causal relationship of material hardship (or income) with children’s outcomes are the family stress hypothesis and the investment model. In these models, stress-related factors and investment-related factors mediate the relationship between material hardship and child (temperament) outcomes. The family stress model suggests that family income (material hardship in this context) increases parental stress, parental depression and relationship conflict which in turn influence parenting behaviours (Cooper & Stewart, 2013; Gershoff et al., 2007; Mayer, 2002). These parenting behaviours in turn influence children’s outcomes. Other research indicates that there is also a direct relationship between poverty and children’s outcomes (Cooper & Stewart, 2013) and between inter-parental relationship quality and children’s outcomes (Dominick, 2018).

In contrast, in the investment model, material hardship is seen as reducing the parent’s ability to invest in goods and services that support positive child development. These goods and services might relate, for example, to nutrition, housing quality, stimulating and enriching physical and social environments, and opportunities for interactions with supportive adults. They are seen as enabling positive social-emotional and cognitive development (Cooper & Stewart, 2013; Mayer, 2002).

Figure 12 outlines the relationship of material hardship with potential confounders and mediators. Potential confounders of the relationship include the mother’s age, ethnicity, highest educational qualification, family and professional support and relationship status.

As noted above, potential mediators (that is, factors on the causal pathway) (Figure 13) proposed by the ‘family stress model’ include maternal depression or anxiety, inter-parental relationship quality, and parenting factors (such as parenting practices, style and attachment). Mediators from the ‘investment model’ are not detailed in this figure as they are numerous. However, all potential mediators were excluded from the final model as they form indirect pathways between material hardship and child outcomes. The indirect effect of material hardship which operates through these mediators is included in the estimate of the total level of association. Future longitudinal research using several time points should be able to assess direct and indirect effects along different pathways, if the relevant data is available.

Several child-related factors potentially influence the outcomes such as age, gender, disability status and genetics. Two variables were tested as potential confounders (child gender and child health/disability status). Child age was not included as all children were approximately nine months of age and relevant genetic information was not available.

Figure 12: Hypothesised pathway of material hardship to child temperament outcomes and potential confounders and parental mediators of the association

Figure 12: Hypothesised pathway of material hardship to child temperament outcomes and potential confounders and parental mediators of the association 

Figure 13: Potential mediators on indirect pathways that were excluded from the final model

Figure 13: Potential mediators on indirect pathways that were excluded from the final model 

## Exposure and Outcome Measures

### Exposure: Material hardship

The material hardship measure used in the analysis is described in sections 2 and 4. The reference category used in all logistic regression analyses was ‘no material hardship items’.

### Outcomes: Infant Temperament Outcomes

The child outcomes examined in this analysis are the three dimensions within the Infant Behavior Questionnaire Revised – Very Short Form (IBQR-VSF):

* ‘Surgency’ (comprising 13 items)
* ‘Negative Affect’ (comprising 12 items)
* ‘Effortful Control’ (comprising 12 items).

Scale scores were calculated in accordance with the scoring procedure obtained from the scale’s authors[[34]](#footnote-34). The scores represent the mean score of scale items[[35]](#footnote-35), as judged by the caregiver.

Descriptive analyses used categorised and continuous values of the dimensions. Binary outcome variables were constructed for each of the factors’ scores as the literature (Gartstein et al., 2012) indicated that the highest and lowest scores of each of the factors were related to later social-emotional problems. Population norms were not available for these scales. Therefore, several different cut-off points were used for binary categories including the top or bottom 12 to 14 percent, 3 percent or 2 percent of scores. These cut-off points were used in the logistic regression analyses. Each of the three scales was analysed separately for each of the cut-off points.

As the distributions approximated normal distributions, linear regressions were conducted to test the associations within a different model.

## Results – unadjusted associations

The unadjusted associations of the exposure variable, outcome variables, potential confounding factors and potential mediating factors were tested prior to conducting the regression analyses.

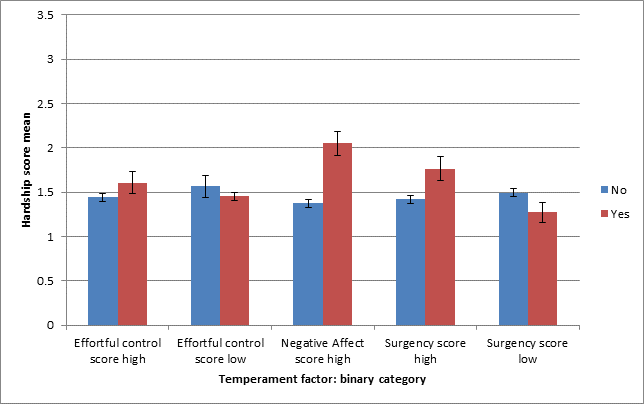
### Material hardship was associated with high ‘Negative Affect’ and high ‘Surgency’ scores but not consistently with low ‘Surgency’ or ‘Effortful Control’ scores

Initial testing of the association of material hardship with the three temperament scales indicated that infant ‘Negative Affect’ was strongly associated with material hardship. The mean hardship score for infants with high ‘Negative Affect’ scores was significantly different from those with lower ‘Negative Affect’ scores (p<0.0001) (Figure 14 and Figure 15). This was the case for three different cut points (top 12%, 3% and 2% of the ‘Negative Affect’ scores). Correlation analysis of scale scores of material hardship items and infant ‘Negative Affect’ resulted in a co-efficient of 0.18.

In contrast, material hardship was not consistently associated with ‘Effortful Control’. T-test results indicated low ‘Effortful Control’ (both cut-points) was not associated with material hardship. High ‘Effortful Control’ was significantly associated with material hardship for the top 13 percent (p<0.05) of scores but not the top 3 percent of scores (Figure 14 and Figure 15). Correlation co-efficient analysis of material hardship and ‘Effortful Control’ scale scores resulted in a co-efficient of 0.002. No further analysis of the relationship between material hardship and ‘Effortful Control’ was conducted based on the unadjusted results.

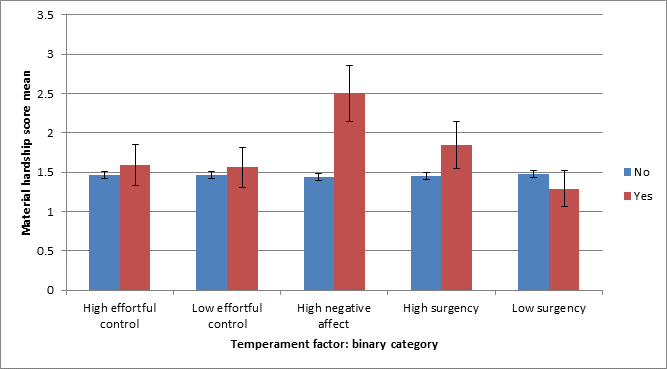
High ‘Surgency’ scores were associated with material hardship (top 14% p<0.0001; top 3% p<0.0001) but inconsistently associated with low ‘Surgency’ scores (Figure 14 and Figure 15). Correlation co-efficient analysis of material hardship and ‘Surgency’ scale scores resulted in a co-efficient of 0.085. However, given inconsistent unadjusted and adjusted results in the relationship between material hardship and ‘Surgency’, more detailed analysis was curtailed.

Figure 14: Mean hardship score by binary child temperament categories for lowest 12%-14% of scores or highest 12-14% of scoresa



a Slightly different cut points were used for the dimensions as the distributions of scale scores differed across the dimensions

Figure 15: Mean hardship score by binary child temperament categories – lowest ~2-3% or highest ~2-3% of scores\*



a Slightly different cut points were used for the dimensions as the distributions of scale scores differed across the dimensions

As only ‘Negative Affect’ scores were strongly and consistently associated with material hardship scores, the following analysis concentrates on the relationship between material hardship and ‘Negative Affect’.

### Material hardship and ‘Negative Affect’ scores were associated with potential confounders

Potential confounders of the relationship include the mother’s age, ethnicity, highest educational qualification, and level of family and professional support. These were all associated with material hardship and ‘Negative Affect’ scores. In summary:

* Age group of mothers was:
  + negatively associated with material hardship, that is younger age groups were associated with higher material hardship
  + negatively associated with the infants’ ‘Negative Affect’ scores; that is, as mother’s age group increased then infants’ ‘Negative Affect’ mean scores decreased.
* Ethnicity of mothers showed variation in relation exposure and outcome variables:
  + Māori and Pacific peoples on average had higher material hardship scores than Asian peoples or European/Other groups (for both prioritised or self-identified main ethnicity). On average, Pacific peoples had higher scores than Māori
  + European/Other had on average the lowest infant ‘Negative Affect’ scores whereas the Pacific peoples group had on average the highest scores. Asian peoples and Māori had similar average scores.
* Highest educational qualification of mothers was:
  + negatively associated with material hardship; that is, higher educational qualifications were associated with lower material hardship
  + negatively associated with infant ‘Negative Affect’ scores; that is, higher educational qualifications were associated with lower infant ‘Negative Affect’ scores.
* Mothers with a partner at the time of the interview:
  + were less likely to have higher material hardship
  + had, on average, children with lower ‘Negative Affect’ scores.
* Low levels of perceived social support (family support or family and professional support) were associated with:
  + greater likelihood of material hardship
  + higher average infant ‘Negative Affect’ scores.

Potential mediators (on the causal pathway) (Figure 13) included maternal depression or anxiety, inter-parental relationship quality, and parenting factors (such as parenting practices, style and attachment). Parenting factors were not available for analysis. These mediating factors were excluded from the estimation of the total level of association of material hardship with temperament outcomes.

‘Negative Affect’ mean scores were associated with mothers’ level of anxiety or depression (p<0.0001), relationship status of mothers (p<0.0001), and child gender (p=0.013).

## Results – adjusted associations

### Material hardship remained significantly associated with infant ‘Negative Affect’ after adjusting for potential confounders

The adjusted association of material hardship with infant ‘Negative Affect’ was tested with three different cut-off points on the ‘Negative Affect’ scale. For the analyses the highest 2 percent, 3 percent or 13 percent of the ‘Negative Affect’ scale scores were categorised as high ‘Negative Affect’. Linear regression was also used to test the association.

Material hardship remained significantly associated with high infant ‘Negative Affect’ compared with no material hardship, after taking into account potential confounders (Tables 18 to 20). The group with four or more hardship items had the highest level of association. However, the association was marginal in two models for the group (Tables 19 and 20) with only one material hardship item compared with those with no material hardship items and not significant in model using the highest 2 percent of scores (Table 18); although, this result might have been due to the low number of respondents in this group.

As would be expected, as more respondents were included in the high ‘Negative Affect’ group, the strength of the association reduced (although statistical precision increased).

Tests of trend, between material hardship categories ‘one item’ and ‘four or more items’, were significant at the 0.01 level for the top 2 percent and 13 percent of ‘Negative Affect’ scores and at the 0.02 level for the top 3 percent of scores. However, ‘two or three items’ of material hardship was not significantly different from the two other levels of material hardship.

Table 18: Adjusted odds of very high infant ‘Negative Affect’ (highest 2% of scores) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Adjusted Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.66 | 0.440660 | 1.91 | 0.056 | 0.99 | 2.79 |
| Two or three vs No items | 1.93 | 0.518275 | 2.46 | 0.014 | 1.14 | 3.27 |
| Four or more vs No items | 3.26 | 0.921228 | 4.18 | 0.000 | 1.87 | 5.67 |

a Adjusted for mother’s age, ethnicity, and highest educational level; level of family and professional support; whether the mother had a current partner; and gender of child.

b Crude conversion of odds ratios to risk ratios: 1.65; 1.9; 3.18. The base rate in the unexposed population is 1.071%.

Table 19: Adjusted odds of very high infant ‘Negative Affect’ (highest 3% of scores) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Adjusted Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.61 | 0.378339 | 2.03 | 0.042 | 1.02 | 2.55 |
| Two or three vs No items | 1.75 | 0.420350 | 2.34 | 0.020 | 1.09 | 2.80 |
| Four or more vs No items | 2.85 | 0.726777 | 4.11 | 0.000 | 1.73 | 4.70 |

a Adjusted for mother’s age, ethnicity, and highest educational level; level of family and professional support; whether the mother had a current partner; and gender of child.

b Crude conversion to risk ratios: 1.6; 1.73; and 2.78. The base rate in the unexposed population is 1.4%.

Table 20: Adjusted odds of high infant ‘Negative Affect’ (highest 13% of scores) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Adjusted Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.28 | .1334889 | 2.41 | 0.016 | 1.05 | 1.57 |
| Two or three vs No items | 1.65 | .1739726 | 4.75 | 0.000 | 1.34 | 2.03 |
| Four or more vs No items | 1.83 | .2288810 | 4.82 | 0.000 | 1.43 | 2.34 |

a Adjusted for mother’s age, ethnicity, and highest educational level; level of family and professional support; whether the mother had a current partner; and gender of child.

b Crude conversion to risk ratios: 1.25 1.56; 1.7. The base rate in the unexposed population is 9.24%.

#### A linear regression test of the association between material hardship and infant ‘Negative Affect’ was also significant

Linear regression was also conducted using the infant ‘Negative Affect’ score as a continuous variable with the same covariates that were used in the logistic regression analysis. These results indicated that the level of association increased as the number of material hardship items increased.

Table 21: Linear regression final model indicating level of association of infant ‘Negative Affect’ with material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Co-efficienta** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | .10 | .0330277 | 3.01 | 0.003 | .04 | .16 |
| Two or three vs No items | .25 | .0362217 | 6.84 | 0.000 | .18 | .32 |
| Four or more vs No items | .34 | . 046975 | 7.15 | 0.000 | .24 | .43 |

a Adjusted for mother’s age, ethnicity, and highest educational level; level of family and professional support; whether the mother had a current partner; gender of child.

#### Material hardship remained associated with high infant ‘Negative Affect’ taking into account levels of maternal anxiety or depression

The infant temperament dimension scores were based on a mother’s responses to a series of questions about her baby. It might be argued that if a mother was anxious or depressed, her responses to the questions may have been coloured by her depression or anxiety. That is, mothers who are depressed or anxious may systematically differ in their responses to the questions because of their depression or anxiety, creating a response set bias. Including anxiety and depression in the regression analyses might take this into account, but it might also be that these variables are operating as mediators and, therefore, any reduction in odds ratios reflects an indirect effect rather than a response set bias.

The results indicated that the odds ratios reduced when anxiety and depression was included in the model. This may be due to mediation effects or response set bias or both. However, the association of material hardship with ‘Negative Affect’ remained significant for higher levels of material hardship across all cut-points (Tables 22-24).

Table 22: Adjusted odds of very high infant ‘Negative Affect’ (highest 2% of scores) by material hardship groups taking into account maternal depression and anxiety

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Adjusted Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.60 | 0.426405 | 1.77 | 0.077 | 0.95 | 2.70 |
| Two or three vs No items | 1.81 | 0.487926 | 2.21 | 0.027 | 1.07 | 3.07 |
| Four or more vs No items | 2.72 | 0.784537 | 3.46 | 0.001 | 1.54 | 4.78 |

a Adjusted for mother’s age, ethnicity, and highest educational level; level of family and professional support; whether the mother had a current partner; gender of child and maternal depression and anxiety.

b Crude conversion of odds ratios to risk ratios 1.59; 1.79; and 2.76. The base rate in the unexposed population is 1.071%.

Table 23: Adjusted odds of very high infant ‘Negative Affect’ (highest 3% of scores) by material hardship groups taking into account maternal depression and anxiety

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Adjusted Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.57 | 0.368638 | 1.91 | 0.056 | 0.99 | 2.48 |
| Two or three vs No items | 1.67 | 0.401630 | 2.12 | 0.034 | 1.04 | 2.67 |
| Four or more vs No items | 2.47 | 0.642985 | 3.48 | 0.001 | 1.48 | 4.11 |

a Adjusted for mother’s age, ethnicity, and highest educational level; level of family support and professional support; whether the mother had a current partner; gender of child and maternal depression and anxiety.

b Crude conversion to risk ratios: 1.56; 1.65; 2.42. The base rate in the unexposed population is 1.4%.

Table 24: Adjusted odds of high infant ‘Negative Affect’ (highest 13% of scores) for material hardship groups taking into account maternal depression and anxiety

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Adjusted Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.25 | .1305126 | 2.13 | 0.033 | 1.02 | 1.53 |
| Two or three vs No items | 1.58 | .1676278 | 4.29 | 0.000 | 1.28 | 1.94 |
| Four or more vs No items | 1.61 | .2060296 | 3.69 | 0.000 | 1.25 | 2.07 |

a Adjusted for mother’s age, ethnicity, and highest educational level; level of family and professional support; whether the mother had a current partner; gender of child; and maternal depression and anxiety.

b Crude conversion to risk ratios: 1.22 1.5; 1.52. The base rate in the unexposed population is 9.24%.

#### Material hardship remained associated with high infant ‘Negative Affect’ taking into account maternal substance use

In the review process, it was suggested that maternal substance use may be an important omitted confounder. Although not part of the original analysis, a test of the final model using the highest 3 percent of ‘Negative Affect’ scores was conducted by including the additional potential confounder of current ‘average number of servings of alcohol per week’ . Including the categorised variable available in the data set, did not change the odds ratios for material hardship significantly. With this confounder added, odds ratios were 1.62, 1.76, and 2.76, which correspond closely to those in Table 19.

Similarly, the test of the same final model but including the additional confounder of ‘use of amphetamines, cocaine, ecstasy, opiates, hallucinogens and party pills since the baby’s birth’ did not change the odds ratios for material hardship significantly. With this potential confounder added, odds ratios for material hardship were 1.62, 1.76 and 2.85.

After adding the potential confounder of ‘marijuana use since the baby’s birth’, the odds ratios for material hardship were 1.61, 1.75, and 2.82. Again the addition of the potential confounder did not change significantly the odds ratios for the final model

### High and low ‘Surgency’ scores were not consistently or strongly associated with material hardship after adjusting for potential confounding

Unadjusted analyses suggested there was an association between material hardship and high infant ‘Surgency’ and inconsistently for low infant ‘Surgency’. However, adjusted logistic regression results using four material hardship categories (including the reference group) did not strongly support the association. Adjusted logistic regression results using three material hardship categories indicated that for the top 14 percent of scores (Table 25) there may be a small association but it was not significant at the .01 level. However, linear regression analyses indicated a small but significant association.

Table 25: Adjusted odds of high infant ‘Surgency’ (highest 14% of scores) for material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | .96 | .0934606 | -0.38 | 0.702 | .80 | 1.17 |
| Two or three vs No items | 1.28 | .1272862 | 2.50 | 0.012 | 1.02 | 1.56 |
| Four or more vs No items | 1.26 | .1566932 | 1.83 | 0.067 | 0.98 | 1.60 |

a Adjusted for mother’s age, ethnicity, and highest educational level; level of family and professional support; whether the mother had a current partner; and gender of child.

b Crude conversion to risk ratios: 0.97; 1.24; 1.22. The base rate in the unexposed population is 12.45%.

#### Linear regression tests suggest there was a small but significant association

Linear regression suggested that material hardship had a relatively small but significant association with ‘Surgency’ after potential confounding was taken into account, for those with two or more material hardship items.

Table 26: Linear regression final model – the association of ‘Surgency’ with material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Co-efficienta** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | -.004 | .0232273 | -0.15 | 0.878 | -.050 | .042 |
| Two or three vs No items | .09 | .0254737 | 3.70 | 0.000 | .04 | .14 |
| Four or more vs No items | .12 | .0334038 | 3.52 | 0.000 | .05 | .18 |

a Adjusted for mother’s age, ethnicity, and highest educational level; level of family and professional support; whether the mother had a current partner; gender of child.

## Summary

The aim of the analysis was to estimate the level of association of material hardship with three infant temperament outcomes. The three outcomes were derived from the IBQR-VSF which measures three separate temperament factors: ‘Surgency’; ‘Negative Affect’; and ‘Effortful Control’. Scale scores were calculated in accordance with the scoring procedure obtained from the authors and represent the mean score of scale items. Each scale was analysed separately.

Binary outcome variables were constructed for use in the logistic regression analysis as the literature indicated that the highest and lowest scores of each of the factors were related to later social-emotional problems. Different cut-off points were used in the logistic regression analysis as there were no New Zealand norms available for the scales. The top and bottom 12 to 14 percent, 3 percent or 2 percent of scores were tested. Linear regression was also conducted to test the association within a different model.

Only the ‘Negative Affect’ scores showed a relatively strong and consistent unadjusted association with material hardship. Therefore, the analysis concentrated on this relationship. The adjusted association of material hardship with infant ‘Negative Affect’ was tested with three different cut-off points on the ‘Negative Affect’ scale. That is, the top 2 percent, 3 percent or 13 percent of the ‘Negative Affect’ scale scores were categorised as high ‘Negative Affect’ in logistic regression analyses. Linear regression was also used to test the association.

In all analyses, higher levels of material hardship were associated with high infant ‘Negative Affect’ after taking into account potential confounders. As would be expected, as greater numbers of respondents were included in the ‘high negative affect’ group, the strength of the association reduced (although statistical precision increased).

For the group with four or more hardship items, the odds of high infant ‘Negative Affect’ were 3.26 times (top 2% of scores), 2.85 times (top 3% of scores) and 1.83 times (top 13% of scores) the odds of the group with no material hardship items. This relates to risk ratios of approximately 3.2, 2.8 and 1.7, respectively compared with the base rates in the unexposed population.

As the child temperament scores were derived from ratings by mothers, it was possible that ratings might have been influenced by a mother’s emotional wellbeing at the time of rating through response bias. It was also hypothesised that maternal anxiety and depression partially mediated material hardship’s relationship with child temperament outcomes. Including depression or anxiety in the final model did slightly reduce the level of association, but it remained significant at 2.7 (top 2%), 2.5 (top 3%) and 1.6 (top 13%) times the odds of those with no material hardship items. The reasons for this slight reduction may have been due to mediation effects, response set bias or both.

# Relationship of material hardship with living in poor quality housing or crowded households and child respiratory conditions/ear infections

## Background

The analysis in this section considers the relationship between material hardship and living in poor quality housing, living in crowded households and child respiratory conditions/ear infections. The hypothesised relationship between material hardship and housing quality, crowding and child respiratory conditions/ear infections used to guide the analysis is outlined in Figure 16. These hypothesised relationships were inferred from national and international literature.

Material hardship has been associated with poorer housing quality in New Zealand (Perry, 2016). As Simpson et al. (2016, p.59) noted, “Problems with dampness, mould, heating and keeping homes warm in winter were more prevalent in households with the lowest after-housing-costs (AHC) incomes…” and “…These three housing quality issues were particularly concentrated in households experiencing multiple lacks across a range of essentials, as reflected in very low scores on the material wellbeing index (MWI)”.

Similarly, material hardship or low incomes have been associated with increased levels of crowding (Ministry of Health, 2014; Perry, 2016; Simpson et al., 2016). Simpson et al. (2016) noted that there is a “strong relationship between household income and household crowding, with crowded households having lower average equivalised incomes than households that are not crowded.”

In turn, crowding and poor quality housing (damp and/or mould) has been associated with poor health and social outcomes. For example, meta-analyses indicate that crowding is associated with increased risk of infectious respiratory diseases (Baker et al., 2013). Fisk et al.'s (2010) meta-analysis showed that residential mould and dampness are associated with significant increases in both respiratory infections and bronchitis. Similarly, Keall et al. (2012) also showed that housing conditions supporting dampness and mould are associated with increased odds of respiratory conditions. Other evidence suggests that crowding may be associated with poorer outcomes for children including academic, behavioural and social outcomes (Ministry of Health, 2014; Solari & Mare, 2012).

Living in damp or overcrowded housing is sometimes incorporated within scales of material hardship. However, national and international evidence suggests that these factors are likely to have a causal relationship with child outcomes such as respiratory conditions. Therefore, these factors may be considered important mediators between family poverty and some child outcomes. Keeping these factors separate will potentially allow any subsequent longitudinal analysis to test the strength of indirect pathways through specific mediators such as housing conditions.

## Methods used to assess the association

The analytic approach used for this analysis paralleled the approaches used in sections 4 and 5. The steps involved:

* delineating the hypothesised pathways between material hardship, housing quality, household crowding and child respiratory conditions/ear infections
* identifying whether material hardship was associated with the outcomes and potential confounders
* conducting step-wise logistic regression with potential confounding factors included in the analysis to obtain the total effect estimate
* testing the sensitivity of several cut-off points.

Figure 16: Hypothesised pathway of material hardship to living in poor quality housing, living in crowded households, and selected child health outcomes with potential confounders of the association

Figure 16: Hypothesised pathway of material hardship to living in poor quality housing, living in crowded households, and selected child health outcomes with potential confounders of the association 

## Exposure and Outcome Measures

Three outcome measures were developed for the analysis outlined in this section. They include a measure of poor quality housing (damp house), two measures of household crowding, and a measure indicating the frequency of children’s respiratory conditions/ear infections since their birth.

### Exposure: Material hardship

The material hardship measure used in the analysis was described in sections 2 and 4. The reference category used in all logistic regression analyses was no material hardship items.

### Outcome: Living in poor quality housing (damp house)

Indicators of housing quality in the GUiNZ dataset included three variables relating to household dampness:

* the baby’s room had mould
* the baby’s room had significant condensation
* the house was damp.

These three binary variables were each associated with material hardship mean scores (refer to section 2; Figure 5: Mean number of endorsed items on material hardship scale by concurrent variables with 95% confidence intervals). A combined variable was created from these three variables by adding each binary variable (0 or 1). This resulted in a variable with a score range of 0 to 3 (Table 27: Percentage of respondents with damp house indicators. Those with a score of two or more were categorised as having poor housing quality (15.4% of all scores) by the level of dampness.

Table 27: Percentage of respondents with damp house indicators

|  |  |  |
| --- | --- | --- |
| **Score from three indicators of damp housing** | **Frequency** | **Percent** |
| **No dampness indicators** | 4269 | 67.01 |
| **One indicator** | 1120 | 17.58 |
| **Two indicators** | 605 | 9.50 |
| **Three indicators** | 377 | 5.92 |
| **Total** | 6371 | 100.00 |

### Outcome measure: Living in crowded household

Internationally, a diverse range of household crowding measures has been used in monitoring and research (Goodyear, Fabian, & Hay, 2011; Gray, 2001; Ministry of Health, 2014). More sophisticated approaches consider the specific ages and genders of the adults and children within the household and the respective sleeping arrangements.

A simpler method was used to develop the household crowding measure for this analysis because the information available within the GUiNZ data set was restricted to the number of adults, children and bedrooms within the household. In addition, the developed measures have unknown levels of error due to the truncation of the adult and child distributions by GUiNZ data managers. Specifically, the maximum number of adults within the household was limited to six. That is, all households with more than six adults were re-categorised as having six adults. Similarly, all households with more than six children were re-categorised as six.

This may mean that levels of household crowding are underestimated and that some households within the dataset that might otherwise be considered ‘crowded’ are not identified as such.

Two measures of crowding were developed for use in the analysis where the number of people (adults and children) in the household **exceeded**:

* 2 per bedroom (Table 28). This measure indicated 11.4% of respondent households were crowded
* 2.5 per bedroom (Table 29). This measure indicated 6.01% of respondent households were crowded.

Table 28: Percentage of respondents living in the household with an average of more than 2 people per bedroom

|  |  |  |
| --- | --- | --- |
| **Average number of people per bedroom** | **Frequency** | **Percent** |
| **Two or less** | 5645 | 88.6 |
| **More than 2** | 726 | 11.4 |
| **Total** | 6371 | 100.0 |

Table 29: Percentage of respondents living in the household with an average of more than 2.5 people per bedroom

|  |  |  |
| --- | --- | --- |
| **Average number of people per bedroom** | **Frequency** | **Percent** |
| **2.5 or less** | 5988 | 94.0 |
| **More than 2.5** | 383 | 6.0 |
| **Total** | 6371 | 100.0 |

### Outcome measure: Number of child respiratory conditions/ear infections

A variable was created for the number of times a child had had a respiratory tract condition or ear infection since their birth. More specifically, the number of times the respondent reported that their child had had:

* an ear infection
* chest infections, wheezing, bronchiolitis, bronchitis, asthma, pneumonia, or croup
* a cough lasting for a week or more.

A continuous outcome variable was **not** able to be created from these variables as the GUiNZ data set contained grouped frequencies (which varied across the three conditions) rather than actual frequencies. To create a variable for analysis, the mid-points of the variables’ categories were assigned as the score. The mid-category numbers were then added across the three variables for each child to create a score.

As a true count variable was not available, from the constructed score, a binary variable was created for the outcome analysis. This represented the group with the highest number of respiratory conditions/ear infections in the cohort. As this was not a true count variable, three cut-off points (the top 6%, 11%, and 12% of scores) were defined as the ‘highest number of respiratory conditions/ear infections’. Each cut-off point was tested in the analysis. Results from the categories using the highest 12 percent and 6 percent of scores are presented below.

## Additional potential confounding factors were used in the analysis

The DAG for this analysis differed in several respects from those in sections 4 and 5. Social support, relationship quality and parenting factors were excluded, while housing tenure and smoking in the household were added.

### Housing tenure was included as a potential confounding factor in the analysis of housing quality and household crowding

Housing tenure was added to the outcome analysis for housing quality and crowding. This was a dichotomous variable of whether the house was owned or not owned by a householder. That is, if the house was owned by someone within the household it was categorised as owned by the household. This variable was constructed from the mother’s nine-month interview and ante-natal interview data sets as the nine-month interview data set had missing values. Table 30 shows just over half the respondents were living in homes not owned by someone living in the household.

Table 30: Percentage of respondents living in homes owned by someone in the household – housing tenure

|  |  |  |
| --- | --- | --- |
| **Ownership of the house** | **Frequency** | **Percent** |
| **Home Not owned by a person in the household** | 3378 | 53.02 |
| **Home owned by a person in the household** | 2993 | 46.98 |
| **Total** | 6371 | 100.00 |

### Maternal smoking was included as a potential confounding factor in the analysis of number of respiratory conditions/ear infections

Smoking was added to the outcome analysis of respiratory conditions/ear infections as it is associated with material hardship while passive smoking is associated with prevalence of respiratory conditions/ear infections (eg Jones et al., 2012).

Three variables relating to household smoking were tested in the analysis:

* whether the mother was a smoker
* whether there were smokers in the household
* the number of smokers in the household.

However, the odds ratios for material hardship and fit statistics in the final models for each of the three variables were very similar. Therefore, results, using the mother’s smoking status at the time of the nine-month interview (Table 31) in the model, are presented below.

Table 31: Percentage of respondents who were current smokers at time of 9 month interview

|  |  |  |
| --- | --- | --- |
| **Mother’s smoking status** | **Frequency** | **Percent** |
| **Mother not currently a smoker** | 5479 | 86.00 |
| **Mother currently a smoker** | 892 | 14.00 |
| **Total** | 6371 | 100.00 |

## Results – unadjusted associations for living in poor quality housing

### Material hardship was significantly associated with living in poor quality housing (damp house)

Unadjusted associations of material hardship with housing quality (housing dampness scale) were statistically significant. Figure 17 shows the mean hardship scores for those with housing dampness score of 0 or 1 compared with those with housing dampness scores of 2 or more (P<0.0001).

Table 32 shows the unadjusted odds of housing dampness for each material hardship category compared with no material hardship items.

Figure 17: Mean material hardship score by damp house indicator score category

Figure 17: Mean material hardship score by damp house indicator score category

Table 32: Unadjusted odds of damp house (2 or more indicators) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Unadjusted Odds Ratio** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.77 | 0.186472 | 5.41 | 0.000 | 1.44 | 2.18 |
| Two or three vs No items | 3.00 | 0.304946 | 10.76 | 0.000 | 2.45 | 3.66 |
| Four or more vs No items | 7.23 | 0.763950 | 18.73 | 0.000 | 5.88 | 8.90 |

#### Material hardship was associated with housing ownership

Housing ownership was a new potential confounder included in this analysis.[[36]](#footnote-36) Material hardship was strongly associated with housing ownership (P<0.0000). Mean material hardship item scores of 0.91 (CI: 0.86-0.95) were obtained for households where someone in the house owned the house and 1.96 (CI: 1.89-2.03) for households who did not have an owner in the house.

### Potential confounders were associated with housing quality

Living in a damp house was significantly associated with the mother’s age, the mother’s ethnicity, the mother’s highest educational level, whether the mother had a partner at the time of nine-month interview, and whether the mother’s house was owned by someone within the household.

When average damp house scores were considered by demographic characteristics, younger age groups (18-24 years: 0.67, CI: 0.61-0.73; 25-29 years: 0.67, CI: 0.62-0.73) were more likely to live in a damp house than those aged 30 years or more (30-34 years: 0.54, CI: 0.42-0.49; 35 years plus: 0.44, CI: 0.40-0.48).

Average damp house scores also differed significantly by ethnicity for both measures of ethnicity (researcher-prioritised and respondent-prioritised). Pacific peoples had the highest mean damp house score (1.03, CI: 0.96-1.11), followed by Māori (0.70, CI: 0.64-0.76), then Asian peoples (0.51, CI: 0.46-0.56), with the European/Other (0.37, CI: 0.35-0.40) having the lowest average score.

Damp house mean scores decreased as educational qualifications increased. For example, the average score for mothers with no school qualifications was 0.92 (CI: 0.82-1.03) while for mothers with a higher degree it was 0.34 (CI: 0.30-0.38).

Mothers without a partner at the time of the nine-month interview were more likely to be living in a damp house (p<0.0001). Those living in houses owned by someone within the household were less likely to be living in a damp house (p<0.0001).

## Results – adjusted associations for living in poor quality housing (damp house)

### Material hardship was significantly associated with housing quality after adjusting for potential confounding

The adjusted association of material hardship with housing quality remained significant after taking into account potential confounding factors (Table 33). Those with four or more hardship items were approximately 3.8 times the odds of those with no hardship items to live in a damp house. This equates to a risk ratio of approximately 3.1.

Table 33: Adjusted odds of damp house by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Adjusted Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.49 | 0.161689 | 3.67 | 0.000 | 1.20 | 1.84 |
| Two or three vs No items | 2.21 | 0.237359 | 7.38 | 0.000 | 1.79 | 2.73 |
| Four or more vs No items | 3.76 | 0.448733 | 11.07 | 0.000 | 2.97 | 4.75 |

a Adjusted for mother’s age, ethnicity, and highest educational level; whether the mother had a current partner; and housing ownership.

b Crude conversion to risk ratios: 1.44; 2.04; 3.11. The base rate in the unexposed population is 7.58%.

## Results – Unadjusted associations for living in a crowded household

### Material hardship was significantly associated with living in a crowded household

Both measures of household crowding were significantly associated with material hardship as indicated by material hardship score means (Figure 5 in section 2) and unadjusted odds ratios (Table 34 and Table 35 below).

Table 34: Unadjusted odds of crowding (on average more than 2.5 people per bedroom) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Unadjusted Odds Ratio** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.58 | 0.253542 | 2.84 | 0.004 | 1.15 | 2.16 |
| Two or three vs No items | 2.39 | 0.369993 | 5.62 | 0.000 | 1.76 | 3.24 |
| Four or more vs No items | 5.25 | 0.800446 | 10.87 | 0.000 | 3.89 | 7.08 |

Table 35: Unadjusted odds of crowding (on average more than 2 people per bedroom) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Unadjusted Odds Ratio** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.56 | 0.183657 | 3.77 | 0.000 | 1.24 | 1.96 |
| Two or three vs No items | 2.27 | 0.262107 | 7.11 | 0.000 | 1.81 | 2.85 |
| Four or more vs No items | 5.93 | 0.680017 | 15.53 | 0.000 | 4.74 | 7.43 |

### Potential confounding factors were significantly associated with household crowding

Household crowding was significantly associated with the mother’s age; the mother’s prioritised ethnicity; the mother’s highest educational level; whether the mother had a partner at the time of nine-month interview; and whether the mother’s house was owned by someone within the household.

Similar to the associations with damp house scores, younger age groups (18-24 years: 1.7, CI: 1.66-1.73; 25-29 years: 1.54, CI: 1.51-1.57) were more likely to live in crowded households than those aged 30 years or more (30-34 years: 1.44, CI: 1.41-1.46; 35 years or more: 1.45, CI: 1.42-1.48). That is, as age group increased, average household crowding scores decreased.

Pacific peoples had the highest average household crowding score (2.04, CI: 1.99-2.09), followed by Māori (1.66, CI: 1.62-1.7) and Asian peoples (1.65, CI: 1.61-1.69), whereas European/other groups had the lowest average household crowding score (1.29, CI: 1.27-1.30).

There was a negative relationship between highest school qualification and average household crowding score. For example, the average score for mothers with no school qualifications was 1.87 (CI: 1.80-1.95) while for mothers with a higher degree it was 1.31 (CI: 1.28-1.34).

Households had lower average crowding scores where the house was owned by someone within the household (1.35, CI: 1.34-1.37) compared with where it was not (1.66, CI: 1.63-1.68). For mothers who did not have a current partner, the average household crowding scores were slightly higher (1.56, CI: 1.51- 1.61) than for mothers with a current partner (1.51, CI: 1.49-1.52) which was only significant at the level of 0.05.

## Results – Adjusted associations for living in a crowded household

### Higher levels of material hardship remained associated with household crowding after adjusting for potential confounding

After adjusting for potential confounding, material hardship remained significantly associated with household crowding for the group with four or more hardship items (p<0.001; Table 36 and Table 37).

Depending on the definition of crowding, the odds ratios were approximately 2.2 (>2 per bedroom) or 1.9 (>2.5 per bedroom) which equates approximately to risk ratios of 2.1 and 1.8 respectively.

Trend analysis for the measure ‘more than 2 per bedroom’ was significant between material hardship category levels ‘2-3’ and ‘4’ also between levels ‘1’ and ‘4’. This means that the two higher material hardship categories were significantly different from each other. However, for the measure more than 2.5 per bedroom, trend analysis was significant between material hardship category levels ‘1’ and ‘4’ only.

Table 36: Adjusted odds of crowding (more than 2 people per bedroom) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Adjusted Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.14 | 0.145154 | 1.05 | 0.294 | 0.89 | 1.47 |
| Two or three vs No items | 1.33 | 0.169686 | 2.25 | 0.024 | 1.04 | 1.71 |
| Four or more vs No items | 2.24 | 0.304422 | 5.94 | 0.000 | 1.72 | 2.93 |

a Adjusted for mother’s age, ethnicity, and highest educational level; whether the mother had a current partner; and housing ownership.

b Crude conversion of odds ratios to risk ratios: 1.13; 1.3; 2.08. The base rate in the unexposed population is 6.222%.

Table 37: Adjusted odds of crowding (more than 2.5 people per bedroom) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Adjusted Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.13 | 0.190601 | 0.71 | 0.48 | 0.81 | 1.57 |
| Two or three vs No items | 1.37 | 0.228489 | 1.88 | 0.06 | 0.99 | 1.90 |
| Four or more vs No items | 1.85 | 0.325740 | 3.51 | 0.000 | 1.31 | 2.62 |

a Adjusted for mother’s age, ethnicity, and highest educational level; whether the mother had a current partner; and housing ownership.

b Crude conversion of odds ratios to risk ratios: 1.13; 1.35; 1.8. The base rate in the unexposed population is 3.173%.

## Results – Unadjusted associations for child’s number of respiratory conditions/ear infections

### Material hardship was associated with child’s number of respiratory conditions/ear infections

Material hardship was associated with number of respiratory conditions/ear infections as indicated by unadjusted odds ratios (Table 38 and Table 39) and average hardship scores for the binary outcome categories (highest 12% and 6% of respiratory condition scores versus lower scores).

Table 38: Unadjusted odds of having a higher number of respiratory conditions/ear infections (highest 12% of respiratory condition scores) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Unadjusted Odds Ratio** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.42 | 0.147058 | 3.43 | 0.001 | 1.16 | 1.74 |
| Two or three vs No items | 1.82 | 0.189103 | 5.75 | 0.000 | 1.48 | 2.23 |
| Four or more vs No items | 2.40 | 0.276378 | 7.57 | 0.000 | 1.91 | 3.00 |

Table 39: Unadjusted odds of having a higher number of respiratory conditions/ear infections (highest 6% of respiratory condition scores) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Unadjusted Odds Ratio** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.57 | 0.240932 | 2.94 | 0.003 | 1.16 | 2.12 |
| Two or three vs No items | 2.41 | 0.356471 | 5.96 | 0.000 | 1.81 | 3.22 |
| Four or more vs No items | 3.15 | 0.503742 | 7.16 | 0.000 | 2.30 | 4.31 |

### Mother’s smoking (new confounder) was associated with material hardship

Material hardship was significantly associated with whether a mother smoked or not (p<0.0000). The average hardship score for mothers who smoked was 2.68 (CI: 2.54-2.82) compared with 1.27 (CI: 1.22-1.31) for mothers who did not smoke.

### Potential confounders were associated with number of respiratory conditions/ear infections

Average number of respiratory conditions/ear infections was significantly associated with the mother’s age, the mother’s ethnicity, the mother’s highest educational level, whether the mother had a partner at the time of nine-month interview, whether the mother’s house was owned by someone within the household, and mother’s smoking status (as well as number of smokers in the household).

Mothers in younger age groups had children with a higher mean number of respiratory conditions/ear infections (18-24 years: 2.87, CI: 2.68-3.05; 25-29 years: 2.19, CI: 2.06-2.33) compared with those aged 30 years or more (30-34 years: 2.00, CI: 1.90-2.11; 35 years or more: 2.11, CI: 1.98-2.24).

Similarly, as mothers’ highest educational qualification category increased, the average number of respiratory conditions/ear infections decreased. For example, the average score for mothers with no school qualifications was 3.18 (CI: 2.83-3.52) while for mothers with a higher degree it was 1.87 (CI: 1.73-2.01).

Māori had the highest average number of respiratory conditions/ear infections (3.12, CI: 2.93-3.31), followed by Pacific peoples (2.74, CI: 2.55-2.94), then European/Other (2.09, CI: 2.00-2.17) and Asian peoples (1.23, CI: 1.11-1.35).

The average number of respiratory conditions/ear infections was lower in households where the house was owned by someone within the household (p<0.0000). Mothers who did not have a partner at the time of the nine-month interview had children with higher average number of respiratory conditions/ear infections compared with mothers who had partners (p<0.0000).

Mothers who were current smokers also had children with higher average number of respiratory conditions/ear infections compared with those who did not smoke (p<0.0000). Number of smokers in the household was also associated with higher average number of respiratory conditions/ear infections.

## Results – adjusted associations for number of respiratory conditions/ear infections

### Material hardship was significantly associated with number of respiratory conditions/ear infections after adjusting for confounding

After taking into account potential confounders, the association of material hardship with number of respiratory conditions/ear infections reduced but remained statistically significant for those with two or three hardship items and four or more hardship items (Table 40 and Table 41).[[37]](#footnote-37) This was the case for both models (the top 6% and top 12% of respiratory condition scores). For those with four or more hardship items, the odds ratios were approximately 1.8 for the model using the highest 6% of scores and 1.6 for the model using the highest 12% of scores. This equates to rate ratios of approximately 1.8 and 1.5 respectively.

Trend analysis was not significant for either of the models.

As the baby’s age at time of the nine-month interview varied across the sample, an additional test was conducted to assess whether this influenced the level of association (odds ratios) for the two models. The odds ratios remained the same (to the first decimal point), when the baby’s age at time of the interview was included in the model.

Table 40: Adjusted odds of having a higher number of respiratory conditions/ear infections (highest 6% of respiratory condition scores) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Adjusted Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.35 | 0.210036 | 1.9 | 0.057 | 0.99 | 1.83 |
| Two or three vs No items | 1.77 | 0.274096 | 3.68 | 0.000 | 1.31 | 2.4 |
| Four or more vs No items | 1.84 | 0.327241 | 3.44 | 0.001 | 1.3 | 2.61 |

a Adjusted for mother’s age, ethnicity, and highest educational level; whether the mother had a current partner; and mother smoking. House ownership was not included in the final model as it was not significant and did not improve fit statistics.

b Crude conversion of odds ratios to risk ratios: 1.33; 1.72; 1.79. The base rate in the unexposed population is 3.505 %.

Table 41: Adjusted odds of having a higher number of respiratory conditions/ear infections (highest 12% of respiratory condition scores) by material hardship groups

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Material hardship group** | **Adjusted Odds Ratioa,b** | **Std. Err.** | **z** | **P>|z|** | **LCL**  **95% CI** | **UCL**  **95% CI** |
| One vs No items | 1.27 | 0.133337 | 2.23 | 0.026 | 1.03 | 1.56 |
| Two or three vs No items | 1.43 | 0.157268 | 3.29 | 0.001 | 1.16 | 1.78 |
| Four or more vs No items | 1.55 | 0.200286 | 3.38 | 0.001 | 1.20 | 2.0 |

a Adjusted for mother’s age, ethnicity, and highest educational level; whether the mother had a current partner; and mother smoking. House ownership was not included in the final model as it was not significant and did not improve fit statistics.

b Crude conversion of odds ratios to risk ratios: 1.24; 1.38; 1.48. The base rate in the unexposed population is 8.742%.

## Summary

The aim of the analyses in this section was to determine the level of association of material hardship with housing quality (having a damp house), household crowding and with the child’s number of respiratory conditions/ear infections. A DAG was constructed, informed by national and international literature to guide the analysis. Two new potential confounding factors were developed for these analyses: household tenure and mother’s smoking.

Three variables were derived from the data and binary outcomes constructed for each variable. Two cut-off points were tested for level of household crowding and child’s number of respiratory conditions/ear infections. Logistic regression was used to estimate the odds ratio of each outcome for three levels of material hardship compared with no material hardship.

For **housing quality**, a measure of housing dampness was derived from three variables and households that scored two or more (15.4%) were categorised as having poor quality housing. Results indicated that after taking into account potential confounding, material hardship was associated with poorer housing at all three levels of material hardship. The odds ratios for poor quality housing were 1.5 (one hardship item), 2.2 (two to three hardship items) and 3.8 (four or more hardship items) times the odds of those with no material hardship. This equates to risk ratios of approximately 1.4, 2.0, and 3.1 respectively. In addition, the trend analysis was significant across each level of material hardship, indicating that the odds of the poor quality housing increased significantly with an increase in level of material hardship.

Two measures of **crowded housing** were derived from the number of adults, children and bedrooms in the household. Having more than two people per bedroom on average comprised the first measure and having more than 2.5 people per bedroom, on average, comprised the second measure. After taking into account potential confounding, the highest level of material hardship was significantly associated with household crowding (for both measures). The odds ratios were 2.2 and 1.9 for the first and second measures respectively. This equates to risk ratios of approximately 2.1 and 1.8 respectively. In addition, the trend analysis indicated that there were significant differences in the odds of household crowding between some levels of material hardship, in particular, for levels ‘2-3’ and ‘4’ and between levels ‘1’ and ‘4’ but not between levels ‘1’ and ‘2-3’.

A measure of **higher number of respiratory conditions/ear infections** was derived from three variables. As the variables in the GUiNZ dataset had been grouped into ranges, a true count variable was not able to be constructed. Rather, the mid-point of each range was used to construct the overall score. Two cut-points were used to define higher numbers of respiratory conditions/ear infections (highest 6% and highest 12% of scores). Both models indicated material hardship was significantly associated with higher numbers of respiratory conditions/ear infections. After taking into account potential confounding, for those with four or more hardship items, the odds ratio was 1.8 times the odds of those with no material hardship items (highest 6% of scores) and 1.6 for the model using the highest 12 percent of scores. This equates to rate ratios of approximately 1.8 and 1.5 respectively. Trend analysis was not significant for either of these models.

# Summary and conclusions

## The study aimed to assess the extent to which material hardship is associated with maternal and child outcomes and provide a baseline for future longitudinal studies

Material hardship has been associated with many family, child and life course outcomes. This research was intended as a first step in developing a better understanding of how material hardship influences child and maternal outcomes within a contemporary New Zealand cohort using the GUiNZ data. The research provides a baseline and framework for future analyses.

The specific question addressed in the research is ‘To what extent is material hardship associated with child and maternal outcomes taking into account potential confounding and mediating factors?’ The methodological approach and the cross-sectional results provide a base for future longitudinal analyses as originally planned.

The cross-sectional analysis had the following steps:

* development of a valid measure of material hardship
* identification of factors influencing the relationship between poverty (material hardship) and each of the outcomes included in the research, from national and international literature
* development of directed acyclic graphs (DAGs) to map the relationships among factors which then provided the theoretical framework for the analysis.
* conducting descriptive analyses
* modelling the relationship between material hardship and outcomes taking into account potential confounding informed by the approaches outlined by Greenland et al (2016), Greenland and Pearce (2015) and Pearl (2010).

The estimates derived from the modelling represent the total level of association of material hardship with specific maternal and child outcomes. That is, the estimates take into account potential confounding but have excluded factors that mediate the relationship between material hardship and the outcome. The estimate of the total level of association between material hardship and the outcome incorporates the association of these mediators. Estimates of the level of effect for mediating factors require longitudinal data, which was not available for this analysis but are planned for future analyses.

### Outcomes were selected for inclusion based on their relevance to the research question, on data availability and on data quality

The outcomes included in the analysis were selected on the basis of their relevance to the research question and MSD, their availability within the data set, and the quality of the data (eg number of missing values).

The outcomes selected for analysis included:

* maternal depression as indicated at the interview held approximately nine months after the birth of their child
* maternal anxiety as indicated at the interview held at approximately nine months after the birth of their child interview
* infant temperament characteristics at nine months after their birth reflecting precursors to socio-emotional outcomes
* mother and child living in poor quality housing (damp house)
* mother and child living in a crowded household
* the number of child respiratory conditions/ear infections since birth.

### Relationships between exposure to material hardship and outcomes, identified in the national and international literature, guided the inclusion of factors in the analysis

The theoretical relationships between material hardship and outcomes were derived from national and international literature. These relationships guided the inclusion of factors in the regression analysis (potential confounding factors) or their exclusion (potential mediators). Potential confounding factors were included in the analysis while potential mediators were excluded because the main aim was to assess the total levels of association of material hardship with the specified outcome. Assessment of mediating factors requires longitudinal data sets. Future longitudinal analyses should be able to assess the extent that the influence of material hardship operates through particular mediators.

Figure 18 outlines the relationship of material hardship with maternal depression and anxiety including potential confounding factors and mediators of the relationship.[[38]](#footnote-38) Similarly, Figure 19 outlines the hypothesised relationship between material hardship and infant temperament outcomes including potential confounding factors and potential mediators of the relationship. Figure 20 outlines the hypothesised relationship of material hardship with quality of housing, household crowding and number of child respiratory conditions/ear infections.

Figure 18: Hypothesised pathways between material hardship and maternal depression or anxiety with potential confounding factors (included in model) and mediating factor (excluded from model)

Figure 18: Hypothesised pathways between material hardship and maternal depression or anxiety with potential confounding factors (included in model) and mediating factor (excluded from model)

Figure 19: Hypothesised pathway of material hardship to child temperament outcomes including potential confounding factors (included in model) and mediating factors (excluded from the model)

Figure 19: Hypothesised pathway of material hardship to child temperament outcomes including potential confounding factors (included in model) and mediating factors (excluded from the model) 

Figure 20: Hypothesised pathway of material hardship to housing quality, household crowding and child respiratory conditions/ear infection with potential confounding factors (included in model)

Figure 20: Hypothesised pathway of material hardship to housing quality, household crowding and child respiratory conditions/ear infection with potential confounding factors (included in model)

## A valid measure of material hardship was developed for use in the analysis

A material hardship scale was developed from GUiNZ mothers’ nine-month interview questionnaire items. Three possible scales were tested using different combinations of the best performing items. Results indicated the scale measured no, low and higher levels of material hardship. That is, the scale discriminated different levels of material hardship but not the full spectrum of material wellbeing. The scale met the requirements of a valid exposure measure for this research.[[39]](#footnote-39) The material hardship scale score or derived categories were used in analyses as a measure of exposure to poverty.

The scale measured the extent of material hardship at a point in time (as the ante-natal data set did not include material hardship scale items). Therefore, a measure of duration of exposure to material hardship across the ante-natal to nine-month interview period was not available. All children in the cohort were a similar age and the analysis is cross-sectional, therefore, the ‘age of exposure to material hardship’ was not relevant for this analysis. However, all regression analyses took into account the mother’s age.

Four levels of material hardship were used in logistic regression analyses:

* no hardship items – the reference category (38 percent of the cohort)
* one hardship item (27 percent of the cohort)
* two or three hardship items (22 percent of the cohort)
* four or more hardship items (13 percent of the cohort were in this group).

## Material hardship was associated with all but one of the outcomes in the study

All but one of the outcomes in the study was found to be associated with material hardship. These included:

* a mother’s likelihood of depression at the nine-month interview
* a mother’s likelihood of anxiety at the nine-month interview
* infant socio-emotional outcomes (temperament) at nine months (two of the three dimensions analysed)
* living in poor quality housing (damp house)
* living in a crowded household
* the number of child respiratory conditions/ear infections during the first nine months.

Infant ‘Effortful Control’ (one of the three infant temperament dimensions) showed no unadjusted association with material hardship and was excluded from regression analysis.

### Material hardship was consistently associated with poorer outcomes but the strength of association varied by outcome type

Overall, results showed that material hardship was significantly associated with all but one of the outcomes included in the study after adjusting for potential confounding. The strength of the association varied across outcomes but the direction was consistent. Higher levels of material hardship were associated with poorer outcomes compared with those with no material hardship across all outcomes (Table 42 and Figure 21).

All three levels of material hardship score categories used in the analysis were significantly associated with the outcome for many of the outcomes including:

* maternal depression
* maternal anxiety
* high infant ‘Negative Affect’ scores
* living in poor quality housing
* high levels of respiratory conditions/ear infections (top 12% of scores).

### For several outcomes, the level of association increased significantly as the level of material hardship increased

Trend analyses were significant for the maternal outcomes of depression and anxiety, indicating a dose-response relationship. That is, not only was each level of material hardship significantly different from those without material hardship, each level of material hardship was significantly different from other levels. This means that the greater the level of material hardship, the greater is the likelihood of maternal depression and anxiety.

Trend analysis was also significant across all levels of material hardship in relation to housing quality (damp housing). That is, as material hardship increased, the greater the likelihood the mother and infant were living in a damp house.

A comparison of those with one hardship item compared with those with four or more hardship items was significant for high infant ‘Negative Affect’ and living in a crowded household (more than 2 people per bedroom) (Table 42). For the second measure of living in a crowded household (more than 2.5 people per bedroom on average), the trend was significant between material hardship levels ‘2-3’ and ‘4’, and between material hardship levels ‘1’ and ‘4’.

The only measure which did not have a significant trend analysis across some or all the material hardship levels was the ‘number of child respiratory conditions/ ear infections’. This may be a reflection of the relationship between material hardship and child respiratory conditions. However, it may also be due to the imprecision in the respiratory scale which was constructed from categories rather than being a true count variable.

Table 42: Adjusted odds and estimated risk ratiose for significant outcome variablesf by level of material hardship

|  |  |  |  |
| --- | --- | --- | --- |
| **Outcomes** | **Odds ratio (95% confidence interval)**  **(Estimated risk ratio)d** | | |
|  | **1 hardship item vs no hardship items** | **2-3 hardship items vs no hardship items** | **4 or more hardship items vs no hardship items** |
| Maternal Depressiona | **1.68** (1.30–2.17)\*\*  (1.63) | **2.55** (1.99–3.27)\*\*  (2.39) | **5.00** (3.81–6.55)\*\*  (4.17) |
| Maternal Anxietya | **1.61** (1.20–2.18)\*  (1.58) | **2.62** (1.96–3.50)\*\*  (2.48) | **5.49** (4.02–7.48)\*\*  (4.75) |
| High infant ‘Negative Affect’ (top 3% of scores)b | **1.61** (1.02–2.55)+  (1.6) | **1.75** (1.09–2.80)+  (1.73) | **2.85** (1.73–4.7)\*\*  (2.78) |
| High infant ‘Negative Affect’ (top 13% of scores)b | **1.28** (1.05–1.57)+  (1.25) | **1.65** (1.34–2.03)\*\*  (1.56) | **1.83** (1.43–2.34)\*\*  (1.70) |
| Living in a Damp Housea | **1.49** (1.20–1.84)\*\*  (1.44) | **2.21** (1.79–2.73)\*\*  (2.04) | **3.76** (2.97–4.75)\*\*  (3.11) |
| Living in a Crowded Household >2 per bedroomc | **1.14** (0.89–1.47)  (1.13) | **1.33** (1.04–1.71)+  (1.30) | **2.24** (1.72–2.93)\*\*  (2.08) |
| Living in a Crowded Household >2.5 per bedroomb | **1.13** (0.81–1.57)  (1.13) | **1.37** (0.99–1.90)  (1.35) | **1.85** (1.31–2.62)\*\*  (1.80) |
| Respiratory conditions/ear infections (top 6% of scores) | **1.35** (0.99–1.83)  (1.33) | **1.77** (1.31–2.40)\*\*  (1.72) | **1.84** (1.30–2.61)\*  (1.79) |
| Respiratory conditions/ear infections (top 12% of scores ) | **1.27** (1.03–1.56)+  (1.24) | **1.43** (1.16–1.78)\*  (1.38) | **1.54** (1.21–2.00)\*  (1.47) |

+ p<0.05; \* p<0.01; \*\*p<0.000;

a Trend analysis is significant across all three material hardship category levels .

b Trend analysis is significant between material hardship category levels ‘1’ and ‘4’ only.

c Trend analysis is significant between material hardship category levels ‘2-3’ and ‘4’ and ‘1’ and ‘4’.

d Derived from the odds ratio and the base rate of outcome in the unexposed population. Refer to Appendix 4 for formula.

e Refer to Appendix 4 for an explanation of the terms odds ratio and risk ratio.

f Note: Infant ‘Surgency’ was not included in this table as the statistical significance of associations with material hardship were inconsistent and those that were significant indicated a relatively small association.

Figure 21: Adjusted odds for significant outcome variables by level of material hardship

Figure 21: Adjusted odds for significant outcome variables by level of material hardship

### The level of association was relatively high for several outcomes and the direction is consistent with previous findings

Material hardship had the highest level of association with maternal anxiety, maternal depression and living in poor quality housing as indicated by the odds ratios (and estimated rate ratios) (Table 42).

The level of association with **maternal anxiety** for the group with four or more hardship items was high, with an odds ratio of 5.5 compared with mothers with no material hardship items, after adjusting for confounding factors. That is, the odds of anxiety for those with four or more material hardship items were five and half times the odds of those with no material hardship items. The estimated risk ratio suggests that those with four or more material hardship items had a risk of anxiety approximately 4.8 times the risk of those without material hardship.

The level of the association with **maternal depression**, for mothers with four or more hardship items, was also relatively high; with an odds ratio of 5.0 compared with mothers with no material hardship items, after adjusting for confounding factors. That is, the odds of depression for those with four or more material hardship items were five times the odds of those with no material hardship items. The estimated risk ratio suggests that those with four or more material hardship items had a risk of depression approximately 4.2 times the risk of those with no material hardship.

These findings are consistent with a range of other evidence (eg Baer et al., 2012; Howard et al., 2014; Kiernan & Mensah, 2009; Kiernan & Huerta, 2008; Mazza et al., 2016; Petterson & Albers, 2009) indicating that material hardship is associated with greater likelihood of maternal depression and anxiety. Maternal depression or anxiety has the potential to influence a mother’s life trajectory but also the development outcomes of her child(ren) (eg Petterson & Albers, 2001; Mazza et al., 2016; Lee & Lee, 2016).

The association of material hardship with a mother and her child(ren) living in **poor quality housing** was not as high as for maternal anxiety and depression but was still relatively high. The odds ratio for mothers with four or more hardship items was approximately 3.8 compared with those with no material hardship items after taking into account potential confounding. The estimated risk ratio suggests that the risk of living in poor quality housing for those with four or more hardship items was 3.1 times the risk of those with no material hardship. These findings are consistent with other research (eg Perry, 2016; Simpson et al, 2016).

Three dimensions of **infant temperament** were tested but only ‘**Negative Affect’** scores were relatively strongly and consistently associated with material hardship. Therefore, the analysis concentrated on this relationship. The adjusted association of material hardship with infant ‘Negative Affect’ was tested with three different cut-off points on the ‘Negative Affect’ scale score (the top 2%, 3% or 13% of scores). Linear regression was also used to test the association. In all analyses, higher levels of material hardship were associated with high infant ‘Negative Affect’ after taking into account potential confounders. As would be expected, as greater numbers of respondents were included in the high ‘Negative Affect’ group, the strength of the association reduced (although statistical precision increased). For the group with four or more hardship items, the odds of high infant ‘Negative Affect’ was approximately 3.3 times (top 2% of scores), 2.9 times (top 3% of scores) and 1.8 times (top 13% of scores) the odds of the group with no material hardship items. This relates to risk ratios of approximately 3.2, 2.8 and 1.7, respectively.

The results of the infant temperament dimensions analysis are consistent with the international literature that exposure to poverty negatively influences socio-emotional development (eg Gershoff et al., 2007). High infant ‘Negative Affect’ has been shown to be associated with internalising and externalising problems later in a child’s development, but high and low ‘Surgency’ and low ‘Effortful Control’ dimensions were only problematic when associated with high ‘Negative Affect’ (Gartstein et al., 2012).

The level of the association between material hardship and living in crowded households and was not as high the outcomes discussed above. However, the direction of the association is consistent with previous research (eg Ministry of Health, 2014; Perry, 2016).

## Strengths and limitations of the research

This research delivered a framework and set of baseline estimates linking material hardship with selected maternal and child outcomes, to inform future longitudinal analysis of the GUiNZ data. Methods for determining level of association followed international standards.

The analysis was conducted using the GUiNZ data set which has a number of strengths including that it includes information from a large heterogeneous contemporary cohort of children and has several robust scales within the questionnaires. Unfortunately, at the time of project initiation, only two main data sets were available for analysis. Material hardship data was available within one of these data sets but not both, therefore only a cross-sectional analysis was feasible. Income data was considered as an alternative exposure measure and was potentially available at two time points. However, there were high levels of missing income data in both ante-natal and nine-month data sets. In addition, the ante-natal data set had missing variables for a number of respondents. Therefore, it was likely that more robust estimates of association would be obtained from an initial cross-sectional analysis.

Information bias (that is, how well the scales measured the exposure or outcomes) may have affected the accuracy of the estimates in several instances. However, as described above, a valid measure of material hardship was able to be developed as a proxy measure of exposure to poverty.

Several robust scales were used as outcome variables. These included the Edinburgh Postnatal Depression Scale (EPDS) and the Generalised Anxiety Disorder (GAD-7) scale. The use of these scales provides some confidence in the level of the estimated association for these maternal outcomes. Sensitivity testing for two cut-points was used for the EPDS as different cut-points have been used internationally. Results from logistic regression were similar for both cut-points.

The measure used for assessing infant temperament dimension outcomes (Infant Behavior Questionnaire Revised Very Short Form: IBQR-VSF) did not have New Zealand norms available. Therefore, three different cut-points were tested in the analysis for the ‘Negative Affect’ dimension. The three cut-points delivered results that were consistent in their direction and all significant although, as would be expected, the level of the estimated association varied depending on the cut-point.

The count of respiratory conditions/ear infections was not a true count, as it was created from grouped count variables. Therefore, this analysis may not fully reflect the level of association between material hardship and children’s respiratory conditions/ear infections.

The measure of household crowding was based on truncated distributions. This may mean that levels of household crowding are underestimated and that some households within the dataset that might otherwise be considered ‘crowded’ are not identified as such.

The social support scale was used in several analyses as a potential confounder. It was derived from items that had been part of a validated questionnaire for social support. However, questions in the scale’s ‘professional support’ component had been modified within the GUiNZ questionnaire. Testing indicated that several of these new items did not contribute to an overall support scale; therefore two reduced scales were used in the analysis. One scale comprised family support items only and the other included two professional support items which operated well within the support scale.

The study did not attempt to weight the results to the New Zealand population because the sample although large and heterogeneous was a non-probability sample (Morton et al., 2013). In addition, the main purpose of this research was to determine the level of association between the exposure to material hardship and outcomes. The large and heterogeneous nature of the cohort means that there is considerable variance across relevant socio-demographic factors and outcomes. Therefore, estimates of the size of the association for this population are likely to be reasonably robust for the more robust outcome measures.

## Conclusion

Results show, in line with the international research, a strong association between material hardship and poor child and maternal outcomes. Maternal mental health, child socio-emotional development indicators, and the number of child respiratory illnesses are all associated with material hardship. As expected, material hardship was associated with living in poor quality housing and living in crowded households.

Up to 14 percent of New Zealand children are exposed to poverty suggesting there is potential to reduce a range of negative outcomes for this group. Future research on poverty, using the GUiNZ longitudinal data, should provide a deeper understanding of the pathways between poverty and maternal and child outcomes; the magnitude of the effect along these pathways; and pinpoint levers for interventions to reduce harm and increase positive outcomes.

# References

Akee, R. K. Q., Copeland, W., Keeler, G., Angold, A., Costello, E. J., & Carolina, N. (2008). *Parents ’ Incomes and Children ’ s Outcomes : A Quasi-Experiment*.

Baer, J. C., Kim, M., & Wilkenfeld, B. (2012). Is it Generalized Anxiety Disorder or Poverty? An Examination of Poor Mothers and Their Children. *Child and Adolescent Social Work Journal*, *29*(4), 345–355. http://doi.org/10.1007/s10560-012-0263-3

Baker, M., McDonald, A., Zhang, J., & Howden-Chapman, P. (2013). *Infectious diseases attributable to household crowding in New Zealand : a systematic review and burden of disease estimate, 2013.* Wellington. Retrieved from http://www.healthyhousing.org.nz/wp-content/uploads/2010/01/HH-Crowding-ID-Burden-25-May-2013.pdf

Barber, P. (2011). How to get closer together: Impacts of income inequality and policy responses. *Policy Quarterly*, *7*(4), 62–68. Retrieved from http://igps.victoria.ac.nz/publications/files/d3ffbb25bdb.pdf

Bland, J. M., & Altman, D. G. (1997). Statistics notes: Cronbach’s alpha. *BMJ*, *314*, 572.

Boden, J. M., Fergusson, D. M., & John Horwood, L. (2008). Early motherhood and subsequent life outcomes. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *49*(2), 151–160. http://doi.org/10.1111/j.1469-7610.2007.01830.x

Boden, J. M., Fergusson, D. M., & John Horwood, L. (2013). Pathways to economic outcomes at age 30: Income and living standards in a New Zealand birth cohort. *New Zealand Sociology*, *28*(3), 102–135.

Brooks-Gunn, J., & Duncan, G. J. (1997). The effects of poverty on children. *Future of Children*. http://doi.org/10.4314/ai.v32i1.22297

Conger, R. D., Conger, K. J., & Martin, M. J. (2010). Socioeconomic Status, Family Processes, and Individual Development. *Journal of Marriage and Family*, *72*(3), 685–704. http://doi.org/10.1111/j.1741-3737.2010.00725.x.Socioeconomic

Cooper, K., & Stewart, K. (2013). *Does money affect children’s outcomes?* *Joseph Rowntree Foundation*. York: Cambridge Publishing Management Limited. Retrieved from http://www.jrf.org.uk/sites/files/jrf/money-children-outcomes-full.pdf

Cox, J. (2017). Use and misuse of the Edinburgh Postnatal Depression Scale (EPDS): a ten point “survival analysis.” *Archives of Women’s Mental Health*, *20*(6), 789–790. http://doi.org/10.1007/s00737-017-0789-7

Cox, J. L., Chapman, G., Murray, D., & Jones, P. (1996). Validation of the Edinburgj postnatal depression scale (EPDS) in non-postnatal women. *Journal of Affective Disorders*, *39*, 185–189.

Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry*, *150*(June), 782–6.

Cummings, P. (2009). The Relative Merits of Risk Ratios and Odds Ratios. *Arch Pediatr Adolesc Med*, *163*(5), 438–445.

Dickerson, A., & Popli, G. (2012). *Persistent poverty and children’s cognitive development: Evidence from the UK Millenium Cohort Study*. London. Retrieved from https://books.google.com/books?id=iDKDAgAAQBAJ&pgis=1

Dominick, C. (2018). *Inter-parental Relationship Quality and its Effects on Children: A literature review to support analysis and policy*. Wellington, NZ: Ministry of Social Development.

Duncan, G. J., Morris, P. a, & Rodrigues, C. (2011). Does Money Really Matter? Estimating Impacts of Family Income on Young Children’s Achievement With Data From Random-Assignment Experiments. *Developmental Psychology*, *47*(5), 1263–1279.

Duncan, G. J., Ziol-Guest, K. M., & Kalil, A. (2010). Early-childhood poverty and adult attainment, behavior, and health. *Child Development*, *81*(1), 306–325. http://doi.org/10.1111/j.1467-8624.2009.01396.x

Dunst, C. J., Trivette, C. M., & Hamby, D. W. (1994). Measuring Social Support in Families with Young Children with Disabilities. In C. J. Dunst, C. M. Trivette, & A. G. Deal (Eds.), *Supporting and strengthening families: methods, strategies and practices. Vol I: Methods, Strategies, and Practices.* (pp. 152–160). Cambridge, MA: Brookline Books.

Expert Advisory Group on Solutions to Child Poverty. (2012a). *Working Paper no.1: Defining and Measuring Child Poverty*. Retrieved from http://www.occ.org.nz/publications/expert-advisory-group/?start=12

Expert Advisory Group on Solutions to Child Poverty. (2012b). *Working Paper no . 3 : What causes child poverty ? What are the consequences ? An economic perspective*. Wellington, NZ. Retrieved from http://www.occ.org.nz/publications/expert-advisory-group/?start=12

Expert Advisory Group on Solutions to Poverty. (2012). *Solutions to child poverty in New Zealand evidence to action*. Wellington, NZ: Children’s Commissioner.

Fisk, W. J., Eliseeva, E. a, & Mendell, M. J. (2010). Association of residential dampness and mold with respiratory tract infections and bronchitis: a meta-analysis. *Environmental Health : A Global Access Science Source*, *9*(1), 72. http://doi.org/10.1186/1476-069X-9-72

Garstein, M., & Rothbart, M. K. (2003). Studying infant temperament via a revision of the Infant Behavior Questionnaire. *Infant Behavior & Development*, *26*, 64–86.

Gartstein, M. A., Putnam, S. P., & Rothbart, M. K. (2012). Etiology of preschool behavior problems: Contributions of temperament attributes in early childhood. *Infant Mental Health Journal*, *33*(2), 197–211. http://doi.org/10.1002/imhj.21312

Gershoff, E. T., Raver, C. C., Aber, J. L., & Lennon, M. C. (2007). Income Is Not Enough: Incorporating Material Hardship Into Models of Income Associations With Parenting and Child Development. *Child Development*, *78*(1), 70–95. http://doi.org/10.1111/j.1467-8624.2007.00986.x

Gibb, S. J., Fergusson, D. M., & Horwood, L. J. (2012). Childhood family income and life outcomes in adulthood: Findings from a 30-year longitudinal study in New Zealand. *Social Science and Medicine*, *74*(12), 1979–1986. http://doi.org/10.1016/j.socscimed.2012.02.028

Gibson, J., McKenzie-McHarg, K., Shakespeare, J., Price, J., & Gray, R. (2009). A systematic review of studies validating the Edinburgh Postnatal Depression Scale in antepartum and postpartum women. *Acta Psychiatrica Scandinavica*, *119*(5), 350–364. http://doi.org/10.1111/j.1600-0447.2009.01363.x

Goodyear, R. K. (Rosemary K., Fabian, A., & Hay, J. (Jane). (2011). *Finding the crowding index that works best for New Zealand : applying different crowding indexes to census of population and dwellings data for 1986-2006*. Wellington.

Gray, A. (2001). *Definitions of crowding and the effects of crowding on health : A Literature review prepared for the Ministry of Social Policy*.

Greenland, S., Daniel, R., & Pearce, N. (2016). Outcome modelling strategies in epidemiology: traditional methods and basic alternatives. *International Journal of Epidemiology*, *45*(2), 565–575. http://doi.org/10.1093/ije/dyw040

Greenland, S., & Pearce, N. (2015). Statistical Foundations for Model-Based Adjustments. *Annual Review of Public Health*, *36*(1), 89–108. http://doi.org/10.1146/annurev-publhealth-031914-122559

Greenland, S., Pearl, J., & Robins, J. M. (1999). Caual Diagrams for Epidemiologic Research. *Epidemiology*, *10*(1), 37–48.

Gunasekara, F. I., & Carter, K. N. (2012). Persistent deprivation in New Zealand children-results from longitudinal survey data. *The New Zealand Medical Journal*, *125*(1365), 38–47.

Gunasekara, F. I., Carter, K. N., Crampton, P., & Blakely, T. (2013). Income and individual deprivation as predictors of health over time. *International Journal of Public Health*, *58*(4), 501–511. http://doi.org/10.1007/s00038-013-0450-9

Hanington, L., Heron, J., Stein, A., & Ramchandani, P. (2012). Parental depression and child outcomes - is marital conflict the missing link? *Child: Care, Health and Development*, *38*(4), 520–529. http://doi.org/10.1111/j.1365-2214.2011.01270.x

Harknett, K. (2006). The relationship between private safety nets and economic outcomes among single mothers. *Journal of Marriage and Family*, *68*(February), 172–191.

Harold, G., Acquah, D., Sellers, R., & Chowdry, H. (2016). *What Works to Enhance Inter-Parental Relationships and Improve Outcomes for Children*. (L. Feinstein, Ed.). University of Sussex and Department for Work & Pensions.

Henly, J. R., Danziger, S. K., & Offer, S. (2005). The contribution of social support to the material well-being of low-income families. *Journal of Marriage & Family*, *67*(1), 122–140. http://doi.org/10.1111/j.0022-2445.2005.00010.x

Howard, L. M., Molyneaux, E., Dennis, C. L., Rochat, T., Stein, A., & Milgrom, J. (2014). Non-psychotic mental disorders in the perinatal period. *The Lancet*, *384*(9956), 1775–1788. http://doi.org/10.1016/S0140-6736(14)61276-9

Jones, L. L., Hassanien, A., Cook, D. G., Britton, J., & Leonardi-Bee, J. (2012). Parental Smoking and the Risk of Middle Ear Disease in Children: A Systematic Review and Meta-analysis. *Arch Pediatr Adolesc Med*, *166*(1), 18–27. http://doi.org/10.1001/archpediatrics.2011.158

Kang, J. (2013). Instrumental social support, material hardship, personal control and neglectful parenting. *Children and Youth Services Review*, *35*(9), 1366–1373. http://doi.org/10.1016/j.childyouth.2013.05.009

Keall, M. D., Crane, J., Baker, M. G., Wickens, K., Howden-Chapman, P., & Cunningham, M. (2012). A measure for quantifying the impact of housing quality on respiratory health: a cross-sectional study. *Environmental Health*, *11*(1), 33. http://doi.org/10.1186/1476-069X-11-33

Kiernan, K. E., & Huerta, M. C. (2008). Economic deprivation, maternal depression, parenting and children’s cognitive and emotional development in early childhood. *British Journal of Sociology*, *59*(4), 783–806. http://doi.org/10.1111/j.1468-4446.2008.00219.x

Kiernan, K. E., & Mensah, F. K. (2009). Poverty, Maternal Depression, Family Status and Children’s Cognitive and Behavioural Development in Early Childhood: A Longitudinal Study. *Journal of Social Policy*, *38*(4), 569. http://doi.org/10.1017/S0047279409003250

Lee, J. S., & Lee, K. (2016). Material Hardships and Social Support Among Australian Families with Children. *Journal of Child and Family Studies*, *25*(5), 1539–1549. http://doi.org/10.1007/s10826-015-0327-z

Magnuson, K. (2013). Reducing the effects of poverty through early childhood interventions Interventions. *Fast Focus*, (17).

Mayer, S. (2002). *The influence of parental income on children’s outcomes*. Wellington, NZ. Retrieved from http://www.msd.govt.nz/documents/about-msd-and-our-work/publications-resources/research/influence-parental-income/influence-of-parental-income.pdf

Mayer, S. (2002). *The influence of parental income on children’s outcomes*. Wellington. Retrieved from http://www.msd.govt.nz/documents/about-msd-and-our-work/publications-resources/research/influence-parental-income/influence-of-parental-income.pdf

Mazza, J. R., Pingault, J.-B., Booij, L., Boivin, M., Tremblay, R., Lambert, J., … Cote, S. (2016). Poverty and behavior problems during early childhood: The mediating role of maternal depression symptoms and parenting. *International Journal of Behavioral Development*, 1–11. http://doi.org/10.1177/0165025416657615

Melchior, M., Chastang, J. F., De Lauzon, B., Galéra, C., Saurel-Cubizolles, M. J., & Larroque, B. (2012). Maternal depression, socioeconomic position, and temperament in early childhood: The EDEN mother-child cohort. *Journal of Affective Disorders*, *137*(1–3), 165–169. http://doi.org/10.1016/j.jad.2011.09.018

Melchior, M., Moffitt, T. E., Milne, B. J., Poulton, R., & Caspi, A. (2007). Why Do Children from Socioeconomically Disadvantaged Families Suffer from Poor Health When They Reach Adulthood? A Life-Course Study. *American Journal of Epidemiology*, *166*(8), 966–974. http://doi.org/10.1093/aje/kwm155

Miller, L. E. (2015). Perceived Threat in Childhood: A Review of Research and Implications for Children Living in Violent Households. *Trauma, Violence, & Abuse*, *16*(2), 153–168. http://doi.org/10.1177/1524838013517563

Ministry of Health. (2014). *Analysis of Household Crowding based on Census2013 data*. Wellington 6140, New Zealand: Ministry of Health.

Ministry of Health. (2016). *Annual Update of Key Results 2015/16: New Zealand Health Survey*. Wellington 6140, New Zealand: Ministry of Health. Retrieved from http://www.health.govt.nz/publication/annual-update-key-results-2015-16-new-zealand-health-survey

Ministry of Social Development. (2016). *The Social Report 2016 Te pūrongo oranga tangata*. Wellington, NZ: Ministry of Social Development. Retrieved from http://socialreport.msd.govt.nz/documents/2016/msd-the-social-report-2016.pdf

Morton, S. M. B., Atatoa carr, P. E., Grant, C. C., Robinson, E. M., Bandara, D. K., Bird, A., … Wall, C. (2013). Cohort profile: Growing up in new zealand. *International Journal of Epidemiology*, *42*(1), 65–75. http://doi.org/10.1093/ije/dyr206

Pearl, J. (2010). An Introduction to Causal Inference. *The International Journal of Biostatistics*, *6*(2). http://doi.org/10.2202/1557-4679.1203

Perry, B. (2015a). *Household incomes in New Zealand: Trends in indicators of inequality and hardship 1982 to 2014*. Wellington, NZ: Ministry of Social Development. Retrieved from https://www.msd.govt.nz/about-msd-and-our-work/publications-resources/monitoring/household-incomes/

Perry, B. (2015b). *The material wellbeing of New Zealand households: Trends are relativities using non-income measures, with international comparisons*. Retrieved from http://www.msd.govt.nz/about-msd-and-our-work/publications-resources/monitoring/living-standards/index.html

Perry, B. (2016). *The material wellbeing of New Zealand households: Trends and relativities using non-income measures, with international comparisons*. Wellington, NZ: Ministry of Social Development.

Perry, B. (2017). *The material wellbeing of New Zealand households: trends and relativities using non-income measures, with international comparisons*. Wellington, NZ: Ministry of Social Development.

Petterson, S. M., & Albers, A. B. (2001). Effects of poverty and maternal depression on early child development. *Child Development*, *72*(6), 1794–813. http://doi.org/10.1111/1467-8624.00379

Poulton, R., Caspi, A., Milne, B. J., Thomson, W. M., Taylor, A., Sears, M. R., & Moffitt, T. E. (2002). Association between children’s experience of socioeconomic disadvantage and adult health: a life-course study. *Lancet*, *360*(9346), 1640–1645. http://doi.org/10.1016/S0140-6736(02)11602-3.Association

Poulton, R., & Ramrakha, S. (2012). *Working Paper no.2: Lifecourse Effects on Childhood Poverty*. Wellington, NZ. Retrieved from http://www.occ.org.nz/publications/expert-advisory-group/?start=12

Poulton, R., & Ramrakha, S. (2012). *Working Paper no.2: Lifecourse Effects on Childhood Poverty*. Wellington, NZ. Retrieved from http://www.occ.org.nz/publications/expert-advisory-group/?start=12

Putnam, S. P., Helbig, A. L., Gartstein, M. A., Rothbart, M. K., & Leerkes, E. (2014). Development and Assessment of Short and Very Short Forms of the Infant Behavior Questionnaire–Revised. *Journal of Personality Assessment*, *96*(4), 445–458. http://doi.org/10.1080/00223891.2013.841171

Rabe-Hesketh, S., & Skrondal, a. (2008). Classical latent variable models for medical research. *Statistical Methods in Medical Research*, *17*(1), 5–32. http://doi.org/10.1177/0962280207081236

Rothbart, M. K. (2012). Early Temperament and Psychosocial Development. In *Encyclopedia on Early Childhood Development*. Cente of Excellence for Early Childhood Development. Retrieved from http://www.child-encyclopedia.com/

Salmond, C., & Crampton, P. (2012). Measuring socioeconomic position in New Zealand. *Journal of Primary Health Care*, *4*(4), 271–280.

Salmond, C., Crampton, P., King, P., & Waldegrave, C. (2006). NZiDep: A New Zealand index of socioeconomic deprivation for individuals. *Social Science and Medicine*, *62*(6), 1474–1485. http://doi.org/10.1016/j.socscimed.2005.08.008

Shahar, E. (n.d.). Commentary On the definition of a confounder. Retrieved from www.u.arizona.edu/~shahar/on confounders.pdf

Shahar, E., & Doron, J. (2012). Causal Diagrams and Three Pairs of Biases. In N. Lunet (Ed.), *Epidemiology - Current Perspectives on Research and Practice*. InTech. http://doi.org/10.5772/33486

Shonkoff, J. P., Richter, L., van der Gaag, J., & Bhutta, Z. a. (2012). An Integrated Scientific Framework for Child Survival and Early Childhood Development. *Pediatrics*, *129*(2), e460–e472. http://doi.org/10.1542/peds.2011-0366

Simpson, J., Duncanson, M., Oben, G., Wicken, A., & S., G. (2016). *Child Poverty Monitor 2016 Technical Report*. Dunedin. Retrieved from http://www.childpoverty.co.nz/sites/default/files/PDFs/2014\_NZ\_Child\_Poverty\_Monitor.pdf

Skrondal, A., & Rabe-Hesketh, S. (2007). Latent variable modelling: A survey. *Scandinavian Journal of Statistics*, *34*(4), 712–745. http://doi.org/10.1111/j.1467-9469.2007.00573.x

Solari, C. D., & Mare, R. D. (2012). Housing crowding effects on children’s wellbeing. *Social Science Research*, *41*(2), 464–476. http://doi.org/10.1016/j.ssresearch.2011.09.012

Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A Brief Measure for Assessing Generalized Anxiety Disorder. *Archives of Internal Medicine*, *166*(10), 1092. http://doi.org/10.1001/archinte.166.10.1092

Statistics New Zealand. (2012). *Vulnerable children and families: Some findings from the New Zealand General Social Survey*.

Streiner, D. L., Norman, G. R., & Cairney, J. (2015). Item response theory. In *Health Measurement Scales: A practical guide to their development and use* (Fifth edit). Great Clarendon Street, Oxford: Oxford University Press / UK.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach’s alpha. *International Journal of Medical Education*, *2*, 53–55. http://doi.org/10.5116/ijme.4dfb.8dfd

Tobias, M., & Mason, K. (2010). *Living standards and health: New Zealand 2006/07*. Wellington.

Underwood, L., Waldie, K. E., D’Souza, S., Peterson, E. R., & Morton, S. M. B. (2017). A Longitudinal Study of Pre-pregnancy and Pregnancy Risk Factors Associated with Antenatal and Postnatal Symptoms of Depression: Evidence from Growing Up in New Zealand. *Maternal and Child Health Journal*, *21*(4), 915–931. http://doi.org/10.1007/s10995-016-2191-x

Vander Weele, T. J., & Shpitser, I. (2013). On the definition of a confounder. *Annals of Statistics*, *41*(1), 196–220. http://doi.org/10.1214/12-AOS1058

VanderWeele, T. J., & Shpitser, I. (2011). A new criterion for confounder selection. *Biometrics*, *67*(4), 1406–1413. http://doi.org/10.1111/j.1541-0420.2011.01619.x.

Weightman, a. L., Morgan, H. E., Shepherd, M. a., Kitcher, H., Roberts, C., & Dunstan, F. D. (2012). Social inequality and infant health in the UK: systematic review and meta-analyses. *BMJ Open*, *2*(3), e000964–e000964. http://doi.org/10.1136/bmjopen-2012-000964

Williams, N. (2014). The GAD-7 questionnaire. *Occupational Medicine*, *64*(3), 224–224. http://doi.org/10.1093/occmed/kqt161

Zocchetti, C., Consonni, D., & Bertazzi, P. A. (1997). Relationship between prevalence rate ratios and odds ratios in cross-sectional studies. *International Journal of Epidemiology*, *26*(1), 220–223. http://doi.org/10.1093/ije/26.1.220

# Appendix 1: Data merge

The GUiNZ data sets were merged to create one data file. The overall process is outlined in Figure 22. Only those observations where the mother’s anonymised identification number (id) matched across all merged data sets were retained in the final file.

Overall, a total of 6,846 children formed the original cohort but this included multiple births. Only one child from multiple births was included in this analysis, leaving a total of 6,753 children. The linkage resulted in for 94% (6,371) of the 6,753 children and their mothers being included in the analysis.For a description of the complete cohort, readers are referred to GUiNZ publications at[***www.growingup.co.nz***](http://www.growingup.co.nz)***.***

For each interview (ante natal, six week and nine month) there is a mother id relating to that data collection. There were several missing mother ids in each of the time periods.

**Data set Dcw0\_idn: IDs linked to the antenatal data**

There are 6,758 Child-Ids linked to the ante-natal mother id and the ante-natal father id. There were no missing child ids. There is one missing mother id in this data set.

**Data set Dcw1c: Linking IDs and 6 week data**

There are 6,847 observations in this dataset.

**Linking Dcw0\_idn (IDs linked to the antenatal data) with Dcw1c (child\_id, 6 week 9 month IDs and 6 week data) by child\_id**

Only 6,758 observations remain when a match is required between the child ids in these two data sets. So there are 89 child\_ids that do not match across these the antenatal id and the post-natal id data sets. Most of these 89 child\_ids relate to multiple births. Only one child from each family was included in the analysis.

Within this linked data set, 383 observations have either missing or non-matching mother ids in the antenatal, six week or nine-month data. Most appear to be missing ids from one of the three time periods rather than different ids (that is a new mother).

In total 472 observations are not able to be matched with child id (89) or have missing mother id (383) from one of the three time periods. This leaves 6,375 observations available for analysis at this stage of the linkage.

When the mother nine-month interview data is matched with the linked **Dcw0\_idn and Dcw1c dataset**, by the mother’s nine-month id then a total of 6,371 observations remain. This link excludes a further 4 observations. Linking the ante-natal mother interview data does not change the number of observations, so after a full linkage, there are 6,371 observations available for analysis.

Figure 22: Data set linkage

Figure 22: Data set linkage

# Appendix 2: Scale analysis results

This appendix contains selected results from the scale analysis.

## Item Response Theory analysis

#### Results from Item Response Theory analysis of two parameter model incorporating all potential scale items

Fitting fixed-effects model:

Iteration 0: log likelihood = -28661.622

Iteration 1: log likelihood = -28136.333

Iteration 2: log likelihood = -28129.187

Iteration 3: log likelihood = -28129.178

Iteration 4: log likelihood = -28129.178

Fitting full model:

Iteration 0: log likelihood = -26936.935 (not concave)

Iteration 1: log likelihood = -25026.905

Iteration 2: log likelihood = -24575.474

Iteration 3: log likelihood = -24361.056

Iteration 4: log likelihood = -24339.968

Iteration 5: log likelihood = -24338.902

Iteration 6: log likelihood = -24338.909

Iteration 7: log likelihood = -24338.909

Two-parameter logistic model Number of obs = 6,371

Log likelihood = -24338.909

------------------------------------------------------------------------------

| Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

Cheaper food |

Discrim | 1.424986 .0606521 23.49 0.000 1.30611 1.543862

Diff | .0066388 .0242221 0.27 0.784 -.0408356 .0541131

-------------+----------------------------------------------------------------

Feeling cold |

Discrim | 1.655146 .0693048 23.88 0.000 1.519311 1.790981

Diff | 1.307959 .0386749 33.82 0.000 1.232157 1.38376

-------------+----------------------------------------------------------------

Food banks/grants|

Discrim | 3.7141 .2143344 17.33 0.000 3.294012 4.134187

Diff | 1.267179 .0263842 48.03 0.000 1.215467 1.318891

-------------+----------------------------------------------------------------

Shoes with holes|

Discrim | 1.792035 .0828205 21.64 0.000 1.629709 1.95436

Diff | 1.728016 .0495053 34.91 0.000 1.630988 1.825045

-------------+----------------------------------------------------------------

Without fresh fruit/vege|

Discrim | 2.187124 .0973071 22.48 0.000 1.996405 2.377842

Diff | 1.482443 .0370943 39.96 0.000 1.40974 1.555147

-------------+----------------------------------------------------------------

Help from comm. org.|

Discrim | 3.094927 .1888099 16.39 0.000 2.724867 3.464988

Diff | 1.861067 .0437255 42.56 0.000 1.775367 1.946768

-------------+----------------------------------------------------------------

Benefit receipt|

Discrim | 1.527401 .0649763 23.51 0.000 1.40005 1.654752

Diff | 1.139476 .0371463 30.68 0.000 1.066671 1.212282

-------------+----------------------------------------------------------------

Unemployment |

Discrim | .7599829 .0626234 12.14 0.000 .6372433 .8827226

Diff | 3.630997 .2600302 13.96 0.000 3.121347 4.140647

-------------+----------------------------------------------------------------

No access to internet|

Discrim | 1.363516 .0613838 22.21 0.000 1.243206 1.483826

Diff | 1.568127 .0524521 29.90 0.000 1.465323 1.670932

-------------+----------------------------------------------------------------

Diff paying baby med care|

Discrim | 2.139046 .1370529 15.61 0.000 1.870427 2.407664

Diff | 2.347038 .0784958 29.90 0.000 2.193189 2.500887

-------------+----------------------------------------------------------------

Baby prescription not affordable|

Discrim | 2.028885 .1337371 15.17 0.000 1.766765 2.291005

Diff | 2.447849 .0877919 27.88 0.000 2.27578 2.619918

-------------+----------------------------------------------------------------

High stress money problems|

Discrim | 1.146418 .0574649 19.95 0.000 1.033789 1.259047

Diff | 1.973727 .0768181 25.69 0.000 1.823167 2.124288

------------------------------------------------------------------------------

#### Results from Item Response Theory analysis of two parameter model incorporating 10 scale items (high stress money problems)

Fitting fixed-effects model:

Iteration 0: log likelihood = -23532.155

Iteration 1: log likelihood = -23061.924

Iteration 2: log likelihood = -23056.766

Iteration 3: log likelihood = -23056.758

Iteration 4: log likelihood = -23056.758

Fitting full model:

Iteration 0: log likelihood = -22286.101 (not concave)

Iteration 1: log likelihood = -20556.141

Iteration 2: log likelihood = -20267.802

Iteration 3: log likelihood = -19876.989

Iteration 4: log likelihood = -19853.342

Iteration 5: log likelihood = -19853.167

Iteration 6: log likelihood = -19853.168

Two-parameter logistic model Number of obs = 6,371

Log likelihood = -19853.168

------------------------------------------------------------------------------

| Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

Cheaper food |

Discrim | 1.769491 .0767364 23.06 0.000 1.619091 1.919892

Diff | .0066899 .0217643 0.31 0.759 -.0359674 .0493471

-------------+----------------------------------------------------------------

Feeling cold |

Discrim | 1.812044 .0765112 23.68 0.000 1.662085 1.962003

Diff | 1.254442 .0357223 35.12 0.000 1.184427 1.324456

-------------+----------------------------------------------------------------

Food banks/grants|

Discrim | 2.743489 .1365405 20.09 0.000 2.475874 3.011103

Diff | 1.356163 .0314891 43.07 0.000 1.294446 1.417881

-------------+----------------------------------------------------------------

Shoes with holes |

Discrim | 1.965145 .0914656 21.49 0.000 1.785876 2.144414

Diff | 1.660189 .045128 36.79 0.000 1.57174 1.748639

-------------+----------------------------------------------------------------

Without fresh fruit/vege |

Discrim | 2.342892 .1078531 21.72 0.000 2.131504 2.55428

Diff | 1.448133 .0354451 40.86 0.000 1.378662 1.517604

-------------+----------------------------------------------------------------

Help from comm. org. |

Discrim | 2.855164 .1750553 16.31 0.000 2.512062 3.198267

Diff | 1.90649 .0474896 40.15 0.000 1.813412 1.999568

-------------+----------------------------------------------------------------

No access to internet|

Discrim | 1.110267 .0551931 20.12 0.000 1.00209 1.218443

Diff | 1.786643 .0705835 25.31 0.000 1.648302 1.924984

-------------+----------------------------------------------------------------

Diff paying baby med care|

Discrim | 2.237856 .1461131 15.32 0.000 1.95148 2.524233

Diff | 2.308909 .0751889 30.71 0.000 2.161541 2.456276

-------------+----------------------------------------------------------------

Baby prescription not affordable|

Discrim | 2.071546 .1384251 14.97 0.000 1.800238 2.342854

Diff | 2.430503 .0863188 28.16 0.000 2.261321 2.599685

-------------+----------------------------------------------------------------

High stress money problems |

Discrim | 1.201185 .0594205 20.21 0.000 1.084723 1.317647

Diff | 1.915459 .07214 26.55 0.000 1.774067 2.056851

------------------------------------------------------------------------------

#### Results from Item Response Theory analysis of two parameter model incorporating 10 scale items (moderate and high stress money problems)

Fitting fixed-effects model:

Iteration 0: log likelihood = -25137.651

Iteration 1: log likelihood = -24662.273

Iteration 2: log likelihood = -24655.976

Iteration 3: log likelihood = -24655.968

Iteration 4: log likelihood = -24655.968

Fitting full model:

Iteration 0: log likelihood = -23670.055 (not concave)

Iteration 1: log likelihood = -21926.017

Iteration 2: log likelihood = -21559.652

Iteration 3: log likelihood = -21363.159

Iteration 4: log likelihood = -21353.668

Iteration 5: log likelihood = -21353.582

Iteration 6: log likelihood = -21353.582

Two-parameter logistic model Number of obs = 6,371

Log likelihood = -21353.582

------------------------------------------------------------------------------

| Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

depq1 |

Discrim | 1.864236 .0796707 23.40 0.000 1.708085 2.020388

Diff | .0083701 .0212771 0.39 0.694 -.0333324 .0500725

-------------+----------------------------------------------------------------

depq2 |

Discrim | 1.791191 .0753031 23.79 0.000 1.6436 1.938783

Diff | 1.261172 .036077 34.96 0.000 1.190463 1.331882

-------------+----------------------------------------------------------------

depq3 |

Discrim | 2.73384 .1358827 20.12 0.000 2.467515 3.000165

Diff | 1.356462 .031609 42.91 0.000 1.294509 1.418414

-------------+----------------------------------------------------------------

depq4 |

Discrim | 1.984387 .0922126 21.52 0.000 1.803653 2.16512

Diff | 1.652844 .0446801 36.99 0.000 1.565273 1.740416

-------------+----------------------------------------------------------------

depq5 |

Discrim | 2.326626 .1068945 21.77 0.000 2.117117 2.536135

Diff | 1.450871 .0356819 40.66 0.000 1.380936 1.520806

-------------+----------------------------------------------------------------

depq6 |

Discrim | 2.835153 .173377 16.35 0.000 2.49534 3.174966

Diff | 1.909019 .0478468 39.90 0.000 1.815241 2.002797

-------------+----------------------------------------------------------------

depq9 |

Discrim | 1.102741 .0546539 20.18 0.000 .9956214 1.209861

Diff | 1.795314 .0709959 25.29 0.000 1.656164 1.934463

-------------+----------------------------------------------------------------

newdepv7 |

Discrim | 2.216888 .1445044 15.34 0.000 1.933665 2.500111

Diff | 2.317261 .0760385 30.47 0.000 2.168229 2.466294

-------------+----------------------------------------------------------------

newdepv8 |

Discrim | 2.04311 .1364733 14.97 0.000 1.775627 2.310593

Diff | 2.44527 .0878634 27.83 0.000 2.273061 2.617479

-------------+----------------------------------------------------------------

moneyprob |

Discrim | 1.057687 .0458184 23.08 0.000 .9678841 1.147489

Diff | .7070766 .0365997 19.32 0.000 .6353424 .7788107

------------------------------------------------------------------------------

#### Results from Item Response Theory analysis of two parameter model incorporating 9 scale items

Fitting fixed-effects model:

Iteration 0: log likelihood = -20993.668

Iteration 1: log likelihood = -20525.481

Iteration 2: log likelihood = -20520.578

Iteration 3: log likelihood = -20520.57

Iteration 4: log likelihood = -20520.57

Fitting full model:

Iteration 0: log likelihood = -20086.961 (not concave)

Iteration 1: log likelihood = -18434.793

Iteration 2: log likelihood = -17947.378

Iteration 3: log likelihood = -17661.953

Iteration 4: log likelihood = -17619.32

Iteration 5: log likelihood = -17617.115

Iteration 6: log likelihood = -17617.086

Iteration 7: log likelihood = -17617.086

Two-parameter logistic model Number of obs = 6,371

Log likelihood = -17617.086

------------------------------------------------------------------------------

| Coef. Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

depq1 |

Discrim | 1.68919 .0755306 22.36 0.000 1.541153 1.837228

Diff | .005016 .0222219 0.23 0.821 -.038538 .0485701

-------------+----------------------------------------------------------------

depq2 |

Discrim | 1.819432 .0781245 23.29 0.000 1.66631 1.972553

Diff | 1.250211 .0359221 34.80 0.000 1.179805 1.320617

-------------+----------------------------------------------------------------

depq3 |

Discrim | 2.799584 .143686 19.48 0.000 2.517965 3.081204

Diff | 1.346923 .0314277 42.86 0.000 1.285326 1.40852

-------------+----------------------------------------------------------------

depq4 |

Discrim | 1.922842 .0902305 21.31 0.000 1.745994 2.099691

Diff | 1.675543 .0464473 36.07 0.000 1.584508 1.766578

-------------+----------------------------------------------------------------

depq5 |

Discrim | 2.295774 .1065806 21.54 0.000 2.08688 2.504668

Diff | 1.457141 .0363252 40.11 0.000 1.385945 1.528337

-------------+----------------------------------------------------------------

depq6 |

Discrim | 2.882703 .1786007 16.14 0.000 2.532652 3.232754

Diff | 1.905373 .0473053 40.28 0.000 1.812656 1.998089

-------------+----------------------------------------------------------------

depq9 |

Discrim | 1.139518 .0564915 20.17 0.000 1.028797 1.250239

Diff | 1.754994 .0684589 25.64 0.000 1.620817 1.889171

-------------+----------------------------------------------------------------

newdepv7 |

Discrim | 2.137876 .1392342 15.35 0.000 1.864982 2.41077

Diff | 2.358276 .0792758 29.75 0.000 2.202898 2.513653

-------------+----------------------------------------------------------------

newdepv8 |

Discrim | 2.014932 .1347562 14.95 0.000 1.750814 2.279049

Diff | 2.466293 .0892564 27.63 0.000 2.291353 2.641232

------------------------------------------------------------------------------

## Internal Consistency: Cronbach’s alpha results

Table 43: Item correlations for all 12 potential scale items

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Scale Item** | **Obs (N)** | **Item-test corr.** | **Item-rest corr.** | **Average inter-item covar.** | **alpha** |
| **Forced to buy cheaper food** | 6371 | 0.5773 | 0.3778 | 0.0198459 | 0.7359 |
| **Feeling cold to save heating costs** | 6371 | 0.5902 | 0.4452 | 0.0202696 | 0.7192 |
| **Using food banks as not enough money** | 6371 | 0.6900 | 0.5884 | 0.0194876 | 0.7014 |
| **Wearing shoes with holes** | 6371 | 0.5391 | 0.4179 | 0.0215688 | 0.7237 |
| **Without fresh fruit & vege due to cost** | 6371 | 0.6088 | 0.4915 | 0.0205487 | 0.7141 |
| **Help (food, clothing, money) from community organisation** | 6371 | 0.5265 | 0.4409 | 0.0225791 | 0.7258 |
| **Benefit receipt (prenatal or antenatal)** | 6371 | 0.5796 | 0.4189 | 0.0202089 | 0.7236 |
| **Unemployed (prenatal)** | 6371 | 0.2958 | 0.1732 | 0.024413 | 0.7484 |
| **No access to internet at home** | 6371 | 0.5240 | 0.3735 | 0.0213128 | 0.7291 |
| **Difficulty paying for medical care for baby** | 6371 | 0.4125 | 0.3336 | 0.0238344 | 0.7361 |
| **Prescription for baby not affordable** | 6371 | 0.3922 | 0.3149 | 0.0240253 | 0.7376 |
| **Money problems source of high stress** | 6371 | 0.4524 | 0.3043 | 0.0224101 | 0.7373 |
| **Test scale** |  |  |  | 0.0217087 | **0.745** |

Table 44: Item correlations for potential scale items excluding unemployment and benefit receipt items

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Scale Item** | **Obs (N)** | **Item-test corr.** | **Item-rest corr.** | **Average inter-item covar.** | **alpha** |
| **Forced to buy cheaper food** | 6371 | 0.6223 | 0.4001 | 0.0205438 | 0.7182 |
| **Feeling cold to save heating costs** | 6371 | 0.6257 | 0.4641 | 0.0211782 | 0.6965 |
| **Using food banks as not enough money** | 6371 | 0.6634 | 0.5364 | 0.0211252 | 0.6853 |
| **Wearing shoes with holes** | 6371 | 0.5724 | 0.4368 | 0.022881 | 0.7024 |
| **Without fresh fruit & vege due to cost** | 6371 | 0.6334 | 0.5012 | 0.0216812 | 0.6914 |
| **Help (food, clothing, money) from community organisation** | 6371 | 0.5298 | 0.4305 | 0.024532 | 0.7086 |
| **Benefit receipt (prenatal or antenatal)** | - | - | - | - | - |
| **Unemployed (prenatal)** | - | - | - | - | - |
| **No access to internet at home** | 6371 | 0.4986 | 0.3177 | 0.0236698 | 0.7223 |
| **Difficulty paying for medical care for baby** | 6371 | 0.4317 | 0.3418 | 0.0260042 | 0.7199 |
| **Prescription for baby not affordable** | 6371 | 0.4055 | 0.3170 | 0.026308 | 0.7223 |
| **Money problems source of high stress** | 6371 | 0.4815 | 0.3131 | 0.0240948 | 0.7215 |
| **Test scale** |  |  |  | 0.0232018 | **0.7306** |

Table 45: Item correlations for potential scale items excluding unemployment and benefit receipt items, money problems item includes moderate and high stress

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Scale Item** | **Obs (N)** | **Item-test corr.** | **Item-rest corr.** | **Average inter-item covar.** | **alpha** |
| **Forced to buy cheaper food** | 6371 | 0.6341 | 0.4267 | 0.0218149 | 0.7015 |
| **Feeling cold to save heating costs** | 6371 | 0.6144 | 0.4576 | 0.023124 | 0.6902 |
| **Using food banks as not enough money** | 6371 | 0.6512 | 0.5273 | 0.0230958 | 0.6804 |
| **Wearing shoes with holes** | 6371 | 0.5644 | 0.4335 | 0.0248607 | 0.6963 |
| **Without fresh fruit & vege due to cost** | 6371 | 0.6192 | 0.4900 | 0.0237101 | 0.6867 |
| **Help (food, clothing, money) from community organisation** | 6371 | 0.5149 | 0.4181 | 0.026679 | 0.7040 |
| **Benefit receipt (prenatal or antenatal)** | - | - | - | - | - |
| **Unemployed (prenatal)** | - | - | - | - | - |
| **No access to internet at home** | 6371 | 0.4884 | 0.314 | 0.0257014 | 0.7151 |
| **Difficulty paying for medical care for baby** | 6371 | 0.4182 | 0.3311 | 0.0281869 | 0.7149 |
| **Prescription for baby not affordable** | 6371 | 0.3920 | 0.3063 | 0.0285018 | 0.7172 |
| **Money problems source of moderate or high stress** | 6371 | 0.5466 | 0.3264 | 0.0240948 | 0.7215 |
| **Test scale** |  |  |  | 0.0249769 | **0.7247** |

Table 46: Item correlations for potential scale items excluding unemployment, benefit receipt and self-identified money problems

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Scale Item** | **Obs (N)** | **Item-test correlation** | **Item-rest correlation** | **Average inter-item covariance** | **alpha** |
| **Forced to buy cheaper food** | 6371 | 0.6239 | 0.3788 | 0.021585 | 0.7162 |
| **Feeling cold to save heating costs** | 6371 | 0.6404 | 0.4667 | 0.021773 | 0.6831 |
| **Using food banks as not enough money** | 6371 | 0.6773 | 0.5415 | 0.021667 | 0.6694 |
| **Wearing shoes with holes** | 6371 | 0.5790 | 0.4317 | 0.023861 | 0.6911 |
| **Without fresh fruit & vege due to cost** | 6371 | 0.6411 | 0.4978 | 0.022441 | 0.6782 |
| **Help (food clothing money) from community organisation** | 6371 | 0.5444 | 0.4380 | 0.025620 | 0.6963 |
| **Benefit receipt (prenatal or antenatal)** | - | - | - | - | - |
| **Unemployed (prenatal)** | - | - | - | - | - |
| **No access to internet at home** | 6371 | 0.5194 | 0.3252 | 0.024578 | 0.7121 |
| **Difficulty paying for medical care for baby** | 6371 | 0.4309 | 0.3329 | 0.027524 | 0.7111 |
| **Prescription for baby not affordable** | 6371 | 0.4118 | 0.3159 | 0.027804 | 0.7131 |
| **Test scale** |  |  |  | 0.024095 | 0.7215 |

# Appendix 3: Unadjusted associations of potential confounders with material hardship, anxiety and depression

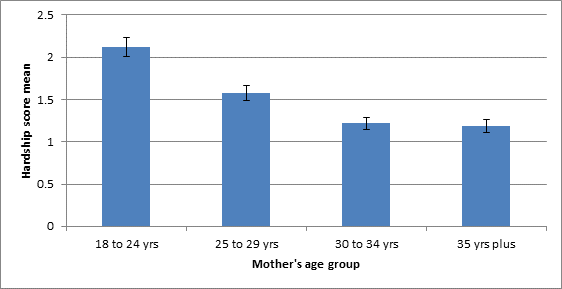
### Unadjusted associations of mother’s demographic characteristics and social support with material hardship

All demographic characteristics and family and professional support had an unadjusted association with material hardship. The proxy measures for parental relationship quality were also associated with maternal depression and anxiety.

#### Mother’s age group is associated with material hardship

Mother’s age group was negatively associated with material hardship (Figure 23). Those in younger age groups had, on average, a higher material hardship scores than older age groups. That is, as age group increased, mean material hardship score decreased up to 30 years of age.

Figure 23: Mean material hardship score by mother’s age group



#### Mother’s ethnicity is associated with material hardship

Ethnicity was also associated with material hardship (Figure 24). Māori and Pacific peoples had, on average, higher material hardship scores than Asian peoples or European/Other groups. This was the case whether prioritised or self-identified main ethnicity was used in the analysis. On average, Pacific peoples had higher scores than Māori, while Asian peoples and European/Other groups had much lower scores than both Māori and Pacific peoples.

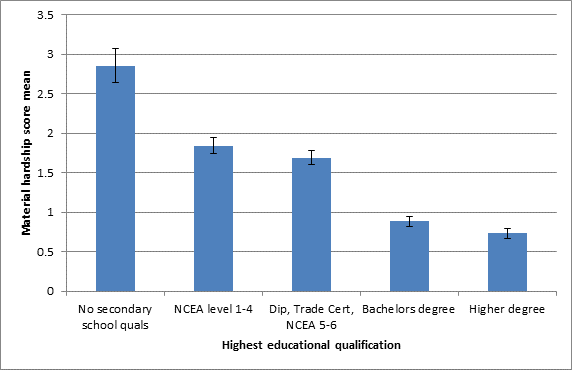
Figure 24: Material hardship score mean by mother’s ethnicity (prioritised and self- identified)

Figure 24: Material hardship score mean by mother’s ethnicity (prioritised and self- identified) 

#### Mother’s highest educational qualification is associated with material hardship

Highest educational qualification was also associated with material hardship (Figure 25). Average material hardship scores decreased as highest educational qualification increased.

Figure 25: Material hardship score mean by mother’s highest educational qualification



#### Levels of family and professional support are associated with material hardship

Levels of social support were also associated with material hardship. Average hardship scores decreased as levels of family and professional support increased (Figure 26). This was the case with both measures used in the analysis (‘family support’ or ‘family and professional support’) and with slightly different category cut-points.

Figure 26: Material hardship score mean by levels of family and professional support

Figure 26: Material hardship score mean by levels of family and professional support

### Unadjusted association of material hardship and potential confounders with maternal depression and anxiety

An unadjusted association between potential confounders and maternal depression or anxiety was confirmed across all potential confounders in the expected direction. The exception was the association of Asian mothers with depression, which was higher than anticipated.

The prevalence of Asian women experiencing psychological distress in the general population is similar to European/Other women (<https://minhealthnz.shinyapps.io/nz-health-survey-2015-16-annual-update/>). However, the psychological distress measure in the health survey includes indicators for both anxiety and depression and the health estimates for Asian women vary considerably across survey years.

#### Mother’s ethnicity is associated with depression and anxiety

Ethnicity was associated with depression (p<0.0001) for both cut-off scores. A greater percentage of Pacific, Māori, and Asian mothers scored 13/12 or above on the EPDS (indicating moderate or high probability of depression) compared with European/Other mothers. Pacific mothers had, on average, the highest percentage of mothers with probable depression (Table 47).

Table 47: Percentage of respondents with moderate or high probability of depression by ethnicity (prioritised categories)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Ethnicity**  **(prioritised category)** | **No or low probability depression**  **(score 13 plus)**  **%** | **Moderate or high probability depression (score 13 plus)**  **%** |  | **No or low probability depression**  **(score 12 plus)**  **%** | **Moderate or high probability depression (score 12 plus)**  **%** | **Total**  **Row % (n)** |
| Asian peoples | 90.75 | 9.25 |  | 86.86 | 13.14 | 100 (951) |
| European/Other | 94.96 | 5.04 |  | 92.98 | 7.02 | 100 (3,376) |
| Māori | 89.19 | 10.81 |  | 86.89 | 13.11 | 100 (1,129) |
| Pacific peoples | 85.07 | 14.93 |  | 80.81 | 19.19 | 100 (891) |
| **Total % (N)** | **91.9 (5834)** | **8.1 (513)** |  | **89.3 (5666)** | **10.7 (681)** | **100 (6347)** |

The pattern of results for anxiety was similar to that found for depression. Ethnicity was associated with anxiety (p<0.0001). A greater percentage of Māori and Pacific mothers had scores of 10 or more on the GAD-7 compared with European/Other and Asian mothers (Table 48). Scores of 10 or over suggest that these respondents may have moderate to severe anxiety.

Table 48: Percentage of respondents with anxiety (GAD-7 scores) by ethnicity (prioritised categories)

|  |  |  |  |
| --- | --- | --- | --- |
| **Ethnicity**  **(prioritised category)** | **No or mild anxiety**  **(score 0 - 9)** | **Moderate to severe anxiety**  **(10 and over)** | **Total**  **Row % (n)** |
| Asian peoples | 93.7 | 6.3 | 100 (953) |
| European/Other | 93.98 | 6.02 | 100(3372) |
| Māori | 89.66 | 10.34 | 100 (1131) |
| Pacific peoples | 87.74 | 12.26 | 100 (889) |
| **Total % (N)** | 92.3 (5856) | 7.7 (489) | **100 (6345)** |

#### Mother’s age group is associated with depression and anxiety

Age group was associated with EPDS scores (p<0.0001). Younger age groups were more likely to have scored 13/12 or above on the EPDS (indicating moderate or high probability of depression) compared with those aged 30 years or above. The 18 to 24 years age group had the highest percentage of respondents with probable depression (Table 49).

Table 49: Percentage of respondents with moderate or high probability of depression by age group of mother

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Mother’s age group** | **No or low probability depression**  **(score 13 plus)**  **%** | **Moderate or high probability depression (score 13 plus)**  **%** |  | **No or low probability depression**  **(score 12 plus)**  **%** | **Moderate or high probability depression (score 12 plus)**  **%** | **Total**  **Row % (n)** |
| 18 to 24 years | 86.72 | 13.28 |  | 83.40 | 16.60 | 100 (1175) |
| 25 to 29 years | 91.10 | 8.90 |  | 88.00 | 12.00 | 100 (1550) |
| 30 to 34 years | 93.90 | 6.10 |  | 91.75 | 8.25 | 100 (2001) |
| 35 years plus | 94.04 | 5.96 |  | 91.71 | 8.29 | 100 (1628) |
| **Total % (N)** | **91.9 (5841)** | **8.1 (513)** |  | **89.3 (5673)** | **10.3 (681)** | **100 (6354)** |

Age group was also associated with anxiety (p<0.0001). A higher percentage of respondents in younger age groups had scores of 10 or more on the GAD-7 compared with respondents aged 30 years or older (Table 50).

Table 50: Percentage of respondents with anxiety (GAD-7 scores) by age group of mother

|  |  |  |  |
| --- | --- | --- | --- |
| **Mother’s age group** | **No or mild anxiety**  **(score 0 - 9) %** | **Moderate to severe anxiety**  **(10 and over) %** | **Total**  **Row % (n)** |
| 18 to 24 years | 88.28 | 11.72 | 100 (1177) |
| 25 to 29 years | 91.15 | 8.85 | 100 (1548) |
| 30 to 34 years | 94.00 | 6.00 | 100 (2001) |
| 35 years plus | 94.22 | 5.78 | 100 (1626) |
| **Total % (N)** | 92.3 (5863) | 7.7 (489) | **100 (6352)** |

#### Highest educational qualification is associated with depression and anxiety

Highest educational qualification was negatively associated with EPDS scores and with GAD-7 scores (p<0.0001). That is, as highest educational qualification increased the percentage of respondents with a moderate or high probability of depression decreased (Table 51). Similarly, the percentage of respondents with higher anxiety scores (GAD-7 score of 10 or more) increased as highest educational qualification decreased (Table 52).

Table 51: Percentage of respondents with depression by highest educational qualification of mother

|  |  |  |  |
| --- | --- | --- | --- |
| **Highest educational qualification** | **No or low probability depression**  **(score 12 plus)**  **%** | **Moderate or high probability depression (score 12 plus)**  **%** | **Total**  **Row % (n)** |
| No secondary school qualification | 81.45 | 18.55 | 100 (415) |
| NCEA level 1-4 | 87.01 | 12.99 | 100 (1478) |
| Diploma/Trade cert/NCEA 5-6 | 87.46 | 12.54 | 100 (1954) |
| Bachelor's degree | 93.46 | 6.54 | 100 (1468) |
| Higher degree | 93.14 | 6.86 | 100 (1021) |
| **Total % (N)** | **89.3 (5656)** | **10.7 (680)** | **100 (6336)** |

Table 52: Percentage of respondents with anxiety (GAD-7 scores) by highest educational qualification of mother

|  |  |  |  |
| --- | --- | --- | --- |
| **Highest educational qualification of mother** | **No or mild anxiety**  **(score 0 - 9)**  **%** | **Moderate to severe anxiety**  **(10 and over)**  **%** | **Total**  **Row % (n)** |
| No secondary school qualification | 86.02 | 13.98 | 100 (415) |
| NCEA level 1-4 | 91.00 | 9.00 | 100 (1478) |
| Diploma/Trade cert/NCEA 5-6 | 91.29 | 8.71 | 100 (1951) |
| Bachelor's degree | 95.18 | 4.82 | 100 (1472) |
| Higher degree | 94.60 | 5.40 | 100 (1018) |
| **Total % (N)** | **92.3 (5847)** | **7.7 (487)** | **100 (6334)** |

#### Whether mother has a partner at time of interview nine months after child’s birth is associated with depression and anxiety

Respondents were asked, at the nine-month interview, whether they had a current partner. Partner status was associated with depression and anxiety. A higher percentage of those without a partner had a moderate or high probability of depression (Table 53). Similarly, a higher percentage of those without a partner may have moderate to severe anxiety (Table 54).

Table 53: Percentage of respondents with depression by current partner status at interview nine months after child’s birth

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner status** | **No or low probability depression**  **(score 12 plus)**  **%** | **Moderate or high probability depression (score 12 plus)**  **%** | **Total**  **Row % (n)** |
| Has current partner | 89.9 | 10.1 | 100 (5816) |
| Does not have current partner | 82.9 | 17.1 | 100 (537) |
| **Total % (N)** | **89.3 (5,672)** | **10.7 (681)** | **100 (6353)** |

Table 54: Percentage of respondents with anxiety (GAD-7 scores) by current partner status at interview nine months after child’s birth

|  |  |  |  |
| --- | --- | --- | --- |
| **Partner status** | **No or mild anxiety**  **(score 0 - 9)** | **Moderate to severe anxiety**  **(10 and over)** | **Total**  **Row % (n)** |
| Has current partner | 92.80 | 7.20 | 100 (5816) |
| Does not have current partner | 86.92 | 13.08 | 100 (535) |
| **Total % (N)** | **92.3 (5862)** | **7.7 (489)** | **100 (6351)** |

#### Levels of family and professional support are associated with depression and anxiety

Social support was associated with both depression (Figure 27) and anxiety (Figure 28). The mean social support scale scores were lower for mothers with an EPDS score of 12 or more and for mothers with a GAD-7 score of 10 or more.

Figure 27: Mean level of perceived support by probability of depression (EPDS)

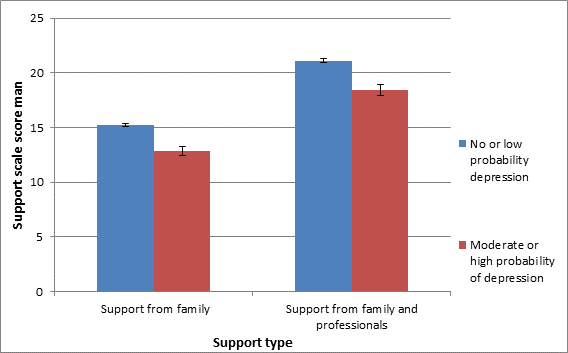
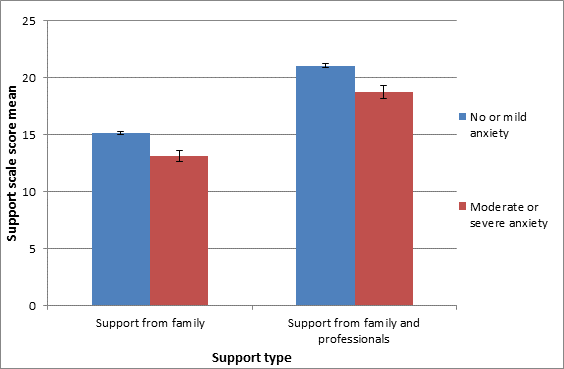


Figure 28: Mean level of perceived support by likelihood of anxiety (GAD-7)



# Appendix 4: Final models

The following tables provide details of the final models described in the body of the report. Two sets are provided within each set of outcome variables. The first model(s) take into account potential confounding factors. The second model takes into account both potential confounding factors and potential mediating factors.

## Models provide an estimate of the association of material hardship with the outcome but do not provide an estimate for the covariates

Note that the final models were designed to estimate the total level of association that material hardship had with the specified outcome. It should also be noted that, as the model was designed to assess the total level of association of material hardship with maternal outcomes, the covariates’ odds ratios within the final model may not be accurate level of their association with the outcome. The levels of association for the covariates may indicate that an independent association remains (or not) between the covariate and the specified outcome, however, the level of that association may be inaccurate as the model was not developed to provide an estimate of that association. New models would need to be developed to estimate the level of association for specific covariates, that is, the covariate of interest would need to be treated as an exposure.

### Explanation of odds ratios and risk ratios

The **risk ratio** is the risk of the outcome among those exposed over the risk of the outcome among those not exposed. Using the following table as a reference, the risk ratio has the formula of RR = [A/(A+B)] / [C/C+D)]. A risk ratio of ‘2’ indicates that the risk of the outcome in the group exposed to material hardship is two times the risk of the outcome in the unexposed group. The approximate risk ratio and level of risk in the unexposed population is provided in sections 4 to 6 for tables detailing the odds ratios obtained from the logistic regression results.

The **odds ratio** is the odds of the outcome among the exposed over the odds of the outcome among those not exposed. Using the following table as a reference, the odds ratio has the formula of OR = (A/B) / C/D). An odds ratio of ‘2’ indicates that the odds of the outcome in the group exposed to material hardship are two times the odds of the outcome in the unexposed group (the reference group used in the logistic regression analysis).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Outcome:**  **Yes** | **Outcome:**  **No** | **Risk** of Outcome | **Odds** of Outcome |
| **Exposed** to material hardship | A | B | A/(A+B) | A/B |
| **Not exposed** to material hardship | C | D | C/(C+D) | C/D |

If the outcome is rare, the odds ratio will approximate the risk ratio. Refer to Cummings, 2009 and Zocchetti, Consonni, & Bertazzi, 1997 for a more detailed discussion of the relationship between odds ratios and risk ratios.

### Conversion of odds ratios into risk ratios

In each of the sections, the odds ratios obtained from logistic regression analyses have been converted into risk ratios using the calculator at [http://clincalc.com/stats/convertor.aspx#](http://clincalc.com/stats/convertor.aspx).

The calculator uses the equation RR=OR / (1−Pref)+(Pref∗OR)

where RR = risk ratio; OR = odds ratio; and Pref = Prevalence of the outcome in the reference group.

### Goodness of fit statistics for the final models

At each stage, model statistics were generated using the fitstat command in STATA 14 to assess the contribution of the factor to the model.[[40]](#footnote-40) Hosmer-Lemeshow goodness of fit tests were applied at each step and the final models and checked with Pearson tests.All the final models had acceptable Hosmer-Lemeshow goodness of fit statistics.

Two final models that included confounding factors only, yielded problematic fit results with the Pearson test. For the maternal anxiety outcome the inclusion of the social support confounder led to a problematic Pearson test result. However, when the relationship quality variable (verbal conflict was a mediator in the model) was included, the model fit results for the Pearson test were acceptable. For the child respiratory conditions/ear infections outcome, only the final model using the top 6% of scores led to problematic Pearson test results. Both tests (Hosmer-Lemeshow and Pearson) showed good model fit for the final model with the top 12 percent of the child respiratory infections.

## Final model for Depression outcome (12+ cut-off) taking into account potential confounding factors

The following are the results for the final model for maternal depression (using EPDS score with a cut-off of 12 and above) and using the social support variable ‘family and professional support’

. logistic EDI\_bincat12 i.hards5cat4 ib4.agemotherr ib4.ethnicityr ib4.EDALL\_AM ib28.totsupcat i.PQ5\_m9M

Logistic regression Number of obs = 6,335

LR chi2(17) = 439.50

Prob > chi2 = 0.0000

Log likelihood = -1939.9647 Pseudo R2 = 0.1017

------------------------------------------------------------------------------

EDI\_bincat12 | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

hards5cat4 |

1 | 1.681704 .217641 4.02 0.000 1.304937 2.167252

2 | 2.550398 .3244065 7.36 0.000 1.987635 3.272499

4 | 4.997932 .6901424 11.65 0.000 3.812867 6.551323

|

agemotherr |

1 | 1.622677 .215359 3.65 0.000 1.251014 2.104758

2 | 1.235482 .155627 1.68 0.093 .9651949 1.581458

3 | .9916721 .1246918 -0.07 0.947 .7750665 1.268812

|

ethnicityr |

1 | 1.211873 .1487775 1.57 0.118 .9527045 1.541545

2 | 1.779983 .2178557 4.71 0.000 1.400347 2.26254

3 | 1.997378 .2468626 5.60 0.000 1.56768 2.544855

|

EDALL\_AM |

0 | 1.210158 .2426301 0.95 0.341 .8169228 1.792683

1 | 1.083367 .1740538 0.50 0.618 .7907178 1.484327

2 | 1.174948 .1790403 1.06 0.290 .8715879 1.583893

3 | .862195 .1439459 -0.89 0.374 .6215771 1.195958

|

totsupcat |

0 | 3.869936 .6725037 7.79 0.000 2.752866 5.440297

14 | 2.538662 .409424 5.78 0.000 1.850662 3.482434

20 | 1.970955 .3154483 4.24 0.000 1.440268 2.697182

|

2.PQ5\_m9M | .8958335 .1209999 -0.81 0.415 .6874732 1.167344

\_cons | .0168331 .0036702 -18.73 0.000 .0109792 .0258082

------------------------------------------------------------------------------

## Final model for Depression outcome (13+ cut-off) taking into account potential confounding factors

The following are the results for the final model for maternal depression (using EPDS score with a cut-off of 13 and above) and using the social support variable ‘family and professional support’

logistic EDI\_bincat i.hards5cat4 ib4.agemotherr ib4.ethnicityr ib4.EDALL\_AM ib28.totsupcat i.PQ5\_m9M

Logistic regression Number of obs = 6,335

LR chi2(17) = 351.18

Prob > chi2 = 0.0000

Log likelihood = -1603.0829 Pseudo R2 = 0.0987

------------------------------------------------------------------------------

EDI\_bincat | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

hards5cat4 |

1 | 1.501467 .2231761 2.73 0.006 1.122004 2.009265

2 | 2.195422 .3196145 5.40 0.000 1.650434 2.92037

4 | 4.75185 .7278438 10.18 0.000 3.519522 6.415667

|

agemotherr |

1 | 1.738121 .2597415 3.70 0.000 1.296815 2.329603

2 | 1.261143 .1821291 1.61 0.108 .9502486 1.673753

3 | 1.027939 .1486347 0.19 0.849 .7742625 1.36473

|

ethnicityr |

1 | 1.371724 .1873584 2.31 0.021 1.049553 1.792788

2 | 1.828538 .25132 4.39 0.000 1.396729 2.393844

3 | 1.915769 .2741827 4.54 0.000 1.447172 2.536098

|

EDALL\_AM |

0 | 1.082385 .2416335 0.35 0.723 .6988083 1.676507

1 | .9941788 .1800204 -0.03 0.974 .6971619 1.417736

2 | 1.11362 .1909436 0.63 0.530 .7957712 1.558425

3 | .7103093 .1381573 -1.76 0.079 .4851614 1.039941

|

totsupcat |

0 | 3.563325 .6952133 6.51 0.000 2.430994 5.223083

14 | 2.293827 .4173736 4.56 0.000 1.605759 3.276734

20 | 1.916947 .3447618 3.62 0.000 1.347479 2.727082

|

2.PQ5\_m9M | .8971382 .133666 -0.73 0.466 .6699425 1.201382

\_cons | .0141967 .0034835 -17.34 0.000 .0087765 .0229641

------------------------------------------------------------------------------

## Final model for Anxiety outcome taking into account potential confounding factors

The following are the results for the final model for maternal anxiety (using GAD-7 with a cut-off of 10 and above) and using the social support variable ‘family and professional support’

logistic AX\_bincat i.hards5cat4 ib4.agemotherr ib4.ethnicityr ib4.EDALL\_AM ib28.totsupcat i.PQ5\_m9M

Logistic regression Number of obs = 6,333

LR chi2(17) = 287.46

Prob > chi2 = 0.0000

Log likelihood = -1573.3297 Pseudo R2 = 0.0837

------------------------------------------------------------------------------

AX\_bincat | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

hards5cat4 |

1 | 1.614514 .2474375 3.13 0.002 1.195607 2.180196

2 | 2.617443 .388579 6.48 0.000 1.956636 3.501422

4 | 5.485173 .8697265 10.73 0.000 4.019983 7.484391

|

agemotherr |

1 | 1.592216 .2453643 3.02 0.003 1.177144 2.153645

2 | 1.387569 .201425 2.26 0.024 1.043977 1.844244

3 | 1.061519 .154126 0.41 0.681 .7986174 1.410968

|

ethnicityr |

1 | 1.089583 .1468461 0.64 0.524 .8366456 1.418989

2 | 1.185501 .1677695 1.20 0.229 .8983422 1.564452

3 | 1.030451 .1623271 0.19 0.849 .7567241 1.403193

|

EDALL\_AM |

0 | 1.060439 .2371769 0.26 0.793 .6840797 1.64386

1 | .9424224 .1714185 -0.33 0.744 .6598108 1.346083

2 | .9839548 .169477 -0.09 0.925 .7020429 1.379071

3 | .8201203 .1540232 -1.06 0.291 .567567 1.185054

|

totsupcat |

0 | 3.641023 .7793831 6.04 0.000 2.393418 5.53896

14 | 2.613254 .5205188 4.82 0.000 1.768625 3.861246

20 | 2.468866 .4830168 4.62 0.000 1.682541 3.622674

|

2.PQ5\_m9M | .9561354 .1445269 -0.30 0.767 .7109745 1.285834

\_cons | .0135891 .0034851 -16.76 0.000 .0082203 .0224645

------------------------------------------------------------------------------

## Final model for Child ‘Negative Affect’ (top 3% of ‘Negative Affect’ scores) taking into account potential confounding factors

The following are the results for the final model for child ‘Negative Affect’ (top 3% of scores) and using the social support variable ‘family and professional support’

. logistic negatbin3 i.hards5cat4 ib4.agemotherr ib4.ethnicityr ib4.EDALL\_AM ib28.totsupcat i.PQ5\_m9M i.GENDER\_PDL

Logistic regression Number of obs = 6,349

LR chi2(18) = 85.53

Prob > chi2 = 0.0000

Log likelihood = -736.78436 Pseudo R2 = 0.0549

------------------------------------------------------------------------------

negatbin3 | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

hards5cat4 |

1 | 1.612045 .3783385 2.03 0.042 1.017664 2.553581

2 | 1.751581 .4203497 2.34 0.020 1.09435 2.803523

4 | 2.850282 .7267768 4.11 0.000 1.729198 4.698191

|

agemotherr |

1 | 1.477832 .3697936 1.56 0.119 .9049643 2.413342

2 | 1.294219 .3131247 1.07 0.286 .8055033 2.07945

3 | 1.074902 .2644268 0.29 0.769 .6637014 1.740866

|

ethnicityr |

1 | 2.540884 .5475336 4.33 0.000 1.665559 3.876232

2 | 1.75924 .4313336 2.30 0.021 1.087993 2.84462

3 | 1.952759 .4853526 2.69 0.007 1.199734 3.178428

|

EDALL\_AM |

0 | 1.845624 .7045476 1.61 0.108 .8733859 3.900143

1 | 1.338994 .4512587 0.87 0.386 .6916917 2.592059

2 | 1.353252 .4397831 0.93 0.352 .7157367 2.558611

3 | 1.368834 .4635254 0.93 0.354 .7048718 2.658223

|

totsupcat |

0 | 1.046574 .2839323 0.17 0.867 .6149523 1.781141

14 | .7910852 .1874105 -0.99 0.323 .4972456 1.258565

20 | .7605984 .17238 -1.21 0.227 .4877995 1.185958

|

2.PQ5\_m9M | 1.055922 .255707 0.22 0.822 .6569025 1.697316

2.GENDER\_PDL | 1.025264 .1615925 0.16 0.874 .7527959 1.396349

\_cons | .0078179 .003103 -12.22 0.000 .0035912 .0170194

------------------------------------------------------------------------------

### Final model for Child ‘Negative Affect’ (top 3% of ‘Negative Affect’ scores) taking into account potential confounding factors and factors affecting interviewee’s response set to the questions

The total effect size was dependent on the level of ‘Negative Affect’ assessed in the model. There are several potential mediating pathways through which part of this effect may operate. As this is a cross-sectional analysis, the direction of effect cannot be tested and would need to be assessed in longitudinal analyses. These potential mediating pathways were excluded from the final models as the level of total association was sought. The pathways include: ‘Maternal depression and anxiety’; ‘Inter-parental relationship quality’; ‘Parenting factors, practices, style or attachment’. However, maternal depression and anxiety may affect a mother’s response set in the interview. Therefore, it may be acting as a mediator of the relationship between material hardship and child ‘Negative Affect’ or a response set bias, or both. An analysis was conducted to ascertain whether including maternal depression and anxiety in the model would substantially affect the results. The following are the results for the final model for infant ‘Negative Affect’ and using the social support variable ‘family and professional support’, including the potential mediating factors of maternal anxiety and maternal depression, as these factors may have affected interviewee response sets to the questions.

logistic negatbin3 i.hards5cat4 ib4.agemotherr ib4.ethnicityr ib4.EDALL\_AM ib28.totsupcat i.PQ5\_m9M i.GENDER\_PDL i.EDI\_bincat12 i.AX\_bincat

Logistic regression Number of obs = 6,315

LR chi2(20) = 94.09

Prob > chi2 = 0.0000

Log likelihood = -731.58511 Pseudo R2 = 0.0604

--------------------------------------------------------------------------------

negatbin3 | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

---------------+----------------------------------------------------------------

hards5cat4 |

1 | 1.566601 .3686384 1.91 0.056 .9877826 2.484594

2 | 1.665834 .4016302 2.12 0.034 1.038504 2.672115

4 | 2.470701 .6429851 3.48 0.001 1.483543 4.11472

|

agemotherr |

1 | 1.4083 .3541524 1.36 0.173 .8602786 2.305426

2 | 1.264493 .3064632 0.97 0.333 .786355 2.033359

3 | 1.062784 .2617726 0.25 0.805 .6558231 1.722277

|

ethnicityr |

1 | 2.546164 .5478493 4.34 0.000 1.670076 3.88183

2 | 1.708666 .4194763 2.18 0.029 1.056058 2.764563

3 | 1.928316 .4811424 2.63 0.008 1.182473 3.144598

|

EDALL\_AM |

0 | 1.850435 .7065456 1.61 0.107 .8755128 3.910978

1 | 1.344964 .4535235 0.88 0.379 .6945195 2.604575

2 | 1.349337 .4389278 0.92 0.357 .713234 2.552754

3 | 1.387323 .4701788 0.97 0.334 .7139967 2.695622

|

totsupcat |

0 | .9610453 .2628 -0.15 0.884 .5623166 1.642505

14 | .748921 .1782179 -1.21 0.224 .469763 1.193969

20 | .7208689 .1643271 -1.44 0.151 .4611252 1.126921

|

2.PQ5\_m9M | 1.066122 .2582369 0.26 0.792 .6631748 1.7139

2.GENDER\_PDL | 1.029068 .1623794 0.18 0.856 .7553191 1.40203

1.EDI\_bincat12 | 1.34907 .3194539 1.26 0.206 .8481517 2.14583

1.AX\_bincat | 1.560561 .4018426 1.73 0.084 .9421008 2.585021

\_cons | .0080237 .0031803 -12.17 0.000 .0036897 .0174486

--------------------------------------------------------------------------------

Note: \_cons estimates baseline odds.

## Final model for Damp House outcomes taking into account potential confounding factors

The following are the results for the final model for housing quality (i.e., a damp house).

logistic housdambin i.hards5cat4 ib4.agemotherr ib4.ethnicityr ib4.EDALL\_AM i.PQ5\_m9M ib1.hhownfin

Logistic regression Number of obs = 6,352

LR chi2(15) = 640.89

Prob > chi2 = 0.0000

Log likelihood = -2407.9256 Pseudo R2 = 0.1174

------------------------------------------------------------------------------

housdambin | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

hards5cat4 |

1 | 1.489247 .1616892 3.67 0.000 1.20379 1.842394

2 | 2.209307 .2373585 7.38 0.000 1.789809 2.727128

4 | 3.755527 .4487325 11.07 0.000 2.971422 4.746543

|

agemotherr |

1 | .924156 .1085862 -0.67 0.502 .7340592 1.163482

2 | 1.28894 .1381279 2.37 0.018 1.044756 1.590197

3 | .9713996 .1057382 -0.27 0.790 .7847719 1.20241

|

ethnicityr |

1 | 1.733446 .1811683 5.26 0.000 1.41237 2.127514

2 | 2.976406 .3099651 10.47 0.000 2.426876 3.650371

3 | 1.657256 .1888772 4.43 0.000 1.325496 2.072053

|

EDALL\_AM |

0 | 1.414934 .2509251 1.96 0.050 .9995021 2.003036

1 | 1.1437 .1654269 0.93 0.353 .8613756 1.518558

2 | 1.174966 .1623259 1.17 0.243 .8962487 1.540359

3 | 1.039462 .1523238 0.26 0.792 .7799602 1.385302

|

2.PQ5\_m9M | .8653581 .1053968 -1.19 0.235 .6815901 1.098673

0.hhownfin | 1.919153 .1669392 7.49 0.000 1.61833 2.275895

\_cons | .0396393 .0059452 -21.52 0.000 .0295435 .0531853

------------------------------------------------------------------------------

## Final models for Household Crowding outcomes taking into account confounding factors

#### Crowding: More than two people per bedroom

The following are the results for the final model for household crowding using the definition of an average of more than 2 people per bedroom in the household.

. logistic crowdingbin i.hards5cat4 ib4.agemotherr ib4.ethnicityr ib4.EDALL\_AM i.PQ5\_m9M ib0.hhownfin

Logistic regression Number of obs = 6,352

LR chi2(15) = 951.65

Prob > chi2 = 0.0000

Log likelihood = -1775.5325 Pseudo R2 = 0.2114

------------------------------------------------------------------------------

crowdingbin | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

hards5cat4 |

1 | 1.142619 .1451539 1.05 0.294 .890775 1.465665

2 | 1.332362 .1696855 2.25 0.024 1.038045 1.710128

4 | 2.24141 .304422 5.94 0.000 1.717567 2.925022

|

agemotherr |

1 | 1.119453 .1476096 0.86 0.392 .8645051 1.449587

2 | .8716339 .1140254 -1.05 0.294 .6744995 1.126384

3 | .9234184 .1219615 -0.60 0.546 .7128123 1.19625

|

ethnicityr |

1 | 5.140481 .7688553 10.95 0.000 3.83434 6.89155

2 | 13.91982 1.999801 18.33 0.000 10.50377 18.44685

3 | 8.062207 1.204848 13.97 0.000 6.015158 10.8059

|

EDALL\_AM |

0 | 2.835153 .6177455 4.78 0.000 1.849737 4.345533

1 | 1.924816 .3607077 3.49 0.000 1.333138 2.779093

2 | 1.395584 .2589407 1.80 0.072 .970111 2.007661

3 | .9300822 .1889914 -0.36 0.721 .6245372 1.38511

|

2.PQ5\_m9M | .5586751 .0826694 -3.93 0.000 .4180264 .7466464

1.hhownfin | .6853758 .0705576 -3.67 0.000 .5601442 .8386053

\_cons | .0191786 .0042246 -17.95 0.000 .0124542 .0295336

------------------------------------------------------------------------------

#### Crowding: More than 2.5 people per bedroom

The following are the results for the final model for household crowding using the definition of an average of more than 2.5 people per bedroom in the household.

. logistic crowdingbin3 i.hards5cat4 ib4.agemotherr ib4.ethnicityr ib4.EDALL\_AM i.PQ5\_m9M ib1.hhownfin

Logistic regression Number of obs = 6,352

LR chi2(15) = 507.89

Prob > chi2 = 0.0000

Log likelihood = -1184.6683 Pseudo R2 = 0.1765

------------------------------------------------------------------------------

crowdingbin3 | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

hards5cat4 |

1 | 1.12676 .190601 0.71 0.480 .8088045 1.56971

2 | 1.369439 .2284894 1.88 0.060 .9874625 1.899174

4 | 1.853887 .3257399 3.51 0.000 1.313777 2.616043

|

agemotherr |

1 | 1.337162 .229183 1.70 0.090 .9556355 1.871009

2 | .8853107 .1571524 -0.69 0.493 .6251698 1.253699

3 | 1.23631 .2140004 1.23 0.220 .8806184 1.735669

|

ethnicityr |

1 | 4.455467 .9163451 7.26 0.000 2.977342 6.66742

2 | 11.18274 2.168075 12.45 0.000 7.647508 16.35221

3 | 7.942957 1.60892 10.23 0.000 5.340272 11.81411

|

EDALL\_AM |

0 | 2.393252 .680258 3.07 0.002 1.371017 4.177668

1 | 1.997177 .4931127 2.80 0.005 1.230979 3.240279

2 | 1.361457 .3357887 1.25 0.211 .8395845 2.207718

3 | .6651253 .1913761 -1.42 0.156 .3784319 1.169013

|

2.PQ5\_m9M | .6490103 .1204134 -2.33 0.020 .451154 .9336377

0.hhownfin | 1.671509 .2330384 3.68 0.000 1.27185 2.196754

\_cons | .0057233 .0016541 -17.87 0.000 .0032482 .0100844

------------------------------------------------------------------------------

## Final model for number of respiratory conditions/ear infections (top 6%) taking into account confounding factors

This model is for the highest 6% of respiratory condition scores. Note that the Hoesmer and Lemeshow goodness of statistic shows good model fit for this model but not the Pearson test.

. logistic earpinfbinm2 i.hards5cat4 ib4.agemotherr ib4.ethnicityr ib4.EDALL\_AM i.PQ5\_m9M ib0.smokermoth

Logistic regression Number of obs = 6,341

LR chi2(15) = 151.05

Prob > chi2 = 0.0000

Log likelihood = -1343.0689 Pseudo R2 = 0.0532

------------------------------------------------------------------------------

earpinfbinm2 | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

hards5cat4 |

1 | 1.345523 .2100361 1.90 0.057 .9908743 1.827106

2 | 1.768796 .2740959 3.68 0.000 1.305491 2.396523

4 | 1.841974 .3272412 3.44 0.001 1.300352 2.609193

|

agemotherr |

1 | 1.359178 .2274384 1.83 0.067 .9791299 1.886741

2 | 1.165853 .1899288 0.94 0.346 .8471782 1.604401

3 | .970211 .1563071 -0.19 0.851 .7075095 1.330455

|

ethnicityr |

1 | 1.691458 .2379528 3.74 0.000 1.283852 2.228474

2 | 1.35475 .2132445 1.93 0.054 .9951206 1.844347

3 | .3334942 .0915168 -4.00 0.000 .1947616 .571049

|

EDALL\_AM |

0 | 1.387945 .3501886 1.30 0.194 .8464627 2.275813

1 | 1.14868 .2417549 0.66 0.510 .7604176 1.735184

2 | 1.114491 .2245074 0.54 0.591 .7509433 1.65404

3 | .9479308 .2057061 -0.25 0.805 .6195285 1.450414

|

2.PQ5\_m9M | 1.151572 .1887204 0.86 0.389 .8352096 1.587766

1.smokermoth | 1.190099 .169068 1.23 0.221 .9008644 1.572195

\_cons | .0323423 .0065804 -16.87 0.000 .0217062 .04819

------------------------------------------------------------------------------

## Final model for number of respiratory conditions/ear infections (top 12%) taking into account confounding factors

This model is for the highest 12% of respiratory condition scores. Note that both the Hoesmer and Lemeshow and Pearson goodness of fit statistic show good model fit for this model.

. logistic earpinfbinm i.hards5cat4 ib4.agemotherr ib4.ethnicityr ib4.EDALL\_AM i.PQ5\_m9M ib0.smokermoth

Logistic regression Number of obs = 6,341

LR chi2(15) = 194.90

Prob > chi2 = 0.0000

Log likelihood = -2259.0981 Pseudo R2 = 0.0414

------------------------------------------------------------------------------

earpinfbinm | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

hards5cat4 |

1 | 1.265054 .1333367 2.23 0.026 1.028946 1.555341

2 | 1.434274 .1572681 3.29 0.001 1.156906 1.778142

4 | 1.548337 .2002861 3.38 0.001 1.201594 1.995139

|

agemotherr |

1 | 1.254666 .1544805 1.84 0.065 .9856533 1.5971

2 | 1.094922 .1268087 0.78 0.434 .8725712 1.373932

3 | 1.0387 .1137078 0.35 0.729 .8381236 1.287278

|

ethnicityr |

1 | 1.507443 .1582194 3.91 0.000 1.227156 1.851749

2 | 1.469137 .1677649 3.37 0.001 1.174522 1.837653

3 | .3420595 .0608405 -6.03 0.000 .2413806 .4847312

|

EDALL\_AM |

0 | 1.018469 .1873045 0.10 0.921 .7102399 1.460463

1 | .9034057 .1291243 -0.71 0.477 .6826846 1.195489

2 | .9753093 .1304541 -0.19 0.852 .7503925 1.267641

3 | .9160358 .1284015 -0.63 0.532 .6959833 1.205663

|

2.PQ5\_m9M | 1.049667 .1350785 0.38 0.706 .8156669 1.350797

1.smokermoth | 1.328625 .142953 2.64 0.008 1.076013 1.640541

\_cons | .0975244 .0128555 -17.66 0.000 .0753199 .126275

------------------------------------------------------------------------------

### Final model for number of respiratory conditions/ear infections taking into account confounding factors and potential mediating factors

This model is for the highest 6% of respiratory condition scores. It takes into account potential confounding factors and includes a potential mediator, which is whether the child was living in a damp house.

. logistic earpinfbinm2 i.hards5cat4 ib4.agemotherr ib4.ethnicityr ib4.EDALL\_AM i.PQ5\_m9M ib0.smokermoth ib0.housdambin

Logistic regression Number of obs = 6,341

LR chi2(16) = 154.97

Prob > chi2 = 0.0000

Log likelihood = -1341.1113 Pseudo R2 = 0.0546

------------------------------------------------------------------------------

earpinfbinm2 | Odds Ratio Std. Err. z P>|z| [95% Conf. Interval]

-------------+----------------------------------------------------------------

hards5cat4 |

1 | 1.327761 .2075819 1.81 0.070 .9773341 1.803834

2 | 1.71913 .2677422 3.48 0.001 1.266893 2.332798

4 | 1.723622 .3124818 3.00 0.003 1.20816 2.459005

|

agemotherr |

1 | 1.365559 .2285095 1.86 0.063 .9837219 1.895608

2 | 1.151873 .1879392 0.87 0.386 .8366099 1.585939

3 | .9703512 .1563672 -0.19 0.852 .7075582 1.330748

|

ethnicityr |

1 | 1.65759 .2340314 3.58 0.000 1.256892 2.186031

2 | 1.2849 .2055145 1.57 0.117 .939124 1.757986

3 | .3277923 .0900191 -4.06 0.000 .191355 .5615103

|

EDALL\_AM |

0 | 1.369114 .3458139 1.24 0.214 .8345283 2.246146

1 | 1.149471 .2419058 0.66 0.508 .7609622 1.736333

2 | 1.109782 .2237617 0.52 0.605 .747503 1.647641

3 | .9518943 .2066204 -0.23 0.820 .6220495 1.456641

|

2.PQ5\_m9M | 1.160971 .1905514 0.91 0.363 .841614 1.601512

1.smokermoth | 1.179808 .1679355 1.16 0.245 .8925863 1.559454

2.housdambin | 1.315044 .1791519 2.01 0.044 1.006882 1.71752

\_cons | .0320135 .0065218 -16.89 0.000 .0214747 .0477243

------------------------------------------------------------------------------

1. For example, not including factors that may confound the relationship between material hardship and an outcome may lead to inflated estimates of the relationship leading to incorrect interpretations. [↑](#footnote-ref-1)
2. Note that these figures are risk ratios. They have been used in this summary for ease of interpretation by general readers. The risk ratios are based on the odds ratios obtained in the analysis. Refer to Table 42 in the research report for summarised results including odds ratios and derived risk ratios. [↑](#footnote-ref-2)
3. In some measures, housing quality is seen as an aspect of material hardship. However, in this study, housing quality was kept separate to allow investigation of the independent impact of material hardship on housing quality and on child respiratory conditions. [↑](#footnote-ref-3)
4. Note that the potential confounding and mediating factors depicted in the diagram are not exhaustive, but reflect the major factors considered in this study, in the relationship between material hardship and the outcome. During the review of the draft report, it was suggested that maternal substance use may also confound the relationships between material hardship and maternal depression or anxiety and between material hardship and infant temperament. This possibility was tested in the review phase. Results did not affect the final model estimates significantly. Refer to sections 4 and 5 for more details. [↑](#footnote-ref-4)
5. As indicated from the results of the Item Response Theory, Exploratory Factor Analysis, Confirmatory Factor Analysis, measures of internal consistency and reliability and concurrent validity testing. Details are provided in section 2. [↑](#footnote-ref-5)
6. <https://www.parliament.nz/en/pb/bills-and-laws/bills-proposed-laws/document/BILL_76267/child-poverty-reduction-bill> [↑](#footnote-ref-6)
7. 2016 figures are available, but MSD reports indicate that the 2016 Household Economic Survey sample was ‘light’ on sole-parent households and on beneficiary households with children (both around 20-25% lower than expected). Under-representation of these groups in the sample is likely to have pulled down the reported low-income and material hardship rates for children in 2016. (Perry 2017, p. 72) [↑](#footnote-ref-7)
8. Only the ante-natal and nine-month GUiNZ data sets were available at the initiation of the project and key data were not available in the ante-natal data set. [↑](#footnote-ref-8)
9. Depending on data quality, an incomes approach may be included in subsequent longitudinal analyses. [↑](#footnote-ref-9)
10. Refer to page 10 for an explanation of the terms ‘difficulty’ and ‘discriminatory’ as used in IRT. [↑](#footnote-ref-10)
11. A tighter criterion is that potential confounding factors must be associated with the outcome in the unexposed population (Tony Blakely, Advanced Epidemiology course 2016). This approach was tested but precise assessment was limited in some cases by low cell numbers. However, all final models were tested excluding factors not meeting this stricter criterion. In all cases the odds ratio estimates for material hardship categories were increased slightly. So the final estimates provided in this report are conservative. [↑](#footnote-ref-11)
12. Statistics included the following. Chi-square: Deviance (df=#); LR (df=#); p-value. R2: McFadden; McFadden (adjusted); Cox-Snell/ML; Cragg-Uhler/Nagelkerke; Efron; Tjur's D. IC: AIC; AIC divided by N; BIC (df=#). [↑](#footnote-ref-12)
13. This ensured that mothers were not included in the data set twice. [↑](#footnote-ref-13)
14. The ante-natal data set did not include sufficient items that could be used for the construction of a material hardship scale and also had much greater levels of missing data. [↑](#footnote-ref-14)
15. <http://www.health.govt.nz/nz-health-statistics/national-collections-and-surveys/surveys/current-recent-surveys/new-zealand-health-survey?mega=Health%20statistics&title=NZ%20Health%20Survey> [↑](#footnote-ref-15)
16. Obtained from the Ministry of Health’s website detailing tier 1 statistics from the New Zealand Health Survey <https://minhealthnz.shinyapps.io/nz-health-survey-2015-16-tier-1/> [↑](#footnote-ref-16)
17. Obtained from the Statistics New Zealand website which has overall and regional estimates available. <http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-national-highlights/phones-internet-access.aspx> or <http://www.stats.govt.nz/census/2013-census/data-tables/regional-summary-tables-part-1.aspx> [↑](#footnote-ref-17)
18. In IRT, the probability of endorsing an item in a scale is called its ‘difficulty’. That is, it indicates how much of the attribute measured by the scale a person must have to endorse the item. IRT assumes that the scale is uni-dimensional and items are independent. In addition, it is assumed that performance on the scale can be predicted by the latent construct score which in IRT is referred to by the Greek letter theta (Streiner et al., 2015). [↑](#footnote-ref-18)
19. Discrimination of the item indicates whether the proportion of people responding positively rises rapidly as theta (scale score) increases. A steep slope in item characteristic curves indicates better discrimination than a flatter curve (Streiner et al., 2015). [↑](#footnote-ref-19)
20. Note that two items from the NZiDep were included initially in testing as they were part of a previously tested and validated scale. However, conceptually benefit receipt did not fit with the more recent conceptualisation of material hardship (Figure 1) as it relates to a source of income, a proxy for level of income. [↑](#footnote-ref-20)
21. Theoretically, as most women in the study were first interviewed during their pregnancy, it is plausible that their employment status during that time was not strongly related to material hardship. This item also had 5% non-response which was converted to non-endorsement of the item. This may have led to higher levels of error for this item. [↑](#footnote-ref-21)
22. As noted above, these items were originally included as they were part of the NZiDep and one option was to use the NZiDep items only as the measure of material hardship. [↑](#footnote-ref-22)
23. Refer to the IDRE webpage for the approach taken to this analysis in STATA <http://www.ats.ucla.edu/stat/stata/faq/efa_categorical.htm> [↑](#footnote-ref-23)
24. Interpretation informed by Thorpe, Geoffrey L. and Favia, Andrej, "Data Analysis Using Item Response Theory Methodology: An Introduction to Selected Programs and Applications." (2012). *Psychology Faculty Scholarship.* Paper 20. http://digitalcommons.library.umaine.edu/psy\_facpub/20 [↑](#footnote-ref-24)
25. CFA was used to test the dimensionality of the data and goodness of fit of the model taking into account covariance between items. An assumption (supported by the initial EFA) was that the items would form a unidimensional scale, hence the use of confirmatory factor analysis at this stage. [↑](#footnote-ref-25)
26. Institute for Digital Research and Evaluation, University of California Los Angeles. http://www.ats.ucla.edu/stat/stata/faq/efa\_categorical.htm [↑](#footnote-ref-26)
27. Note that half of all respondents endorsed the item stating “In the last 12 months have you personally: been forced to buy cheaper food so that you could pay for other things you needed”. [↑](#footnote-ref-27)
28. Some might argue that several of these factors could have been considered for inclusion in the material hardship scale. However, poor quality housing (dampness and crowding) and mother’s smoking are known to be associated with child respiratory conditions, which was one of the outcomes for analysis (refer to section 6 for details). Hence, they were excluded from the scale to ensure that exposure was not conflated with mediators of an outcome in the analysis. [↑](#footnote-ref-28)
29. Note that the raw category score was used for this analysis, not an equivalised category. Therefore the analysis does not take into account the number and age of people living in the household who rely on the household income. An equivalised income indicator is scheduled to be developed in the next phase of the research, if the requisite data items are available in the relevant GUiNZ external datasets. [↑](#footnote-ref-29)
30. The number of mothers whose age was reclassified was not provided in the data set. [↑](#footnote-ref-30)
31. Statistics included the following. Chi-square: Deviance (df=#); LR (df=#); p-value. R2: McFadden; McFadden (adjusted); Cox-Snell/ML; Cragg-Uhler/Nagelkerke; Efron; Tjur's D. IC: AIC; AIC divided by N; BIC (df=#). [↑](#footnote-ref-31)
32. For example scoring sheets obtained from New Zealand <http://www.bpac.org.nz/BPJ/2010/nataldep/postnatal.aspx> and <https://www.healthpoint.co.nz/download,146397.do> and internationally <http://www.perinatalservicesbc.ca/health-professionals/professional-resources/health-promo/edinburgh-postnatal-depression-scale-(epds)> (2015 revision British Columbia) and <http://www.fresno.ucsf.edu/pediatrics/downloads/edinburghscale.pdf>. [↑](#footnote-ref-32)
33. This is close to the prevalence estimate obtained by Underwood et al. (2017) who found 8% of 5,301 women had depression at the time of the nine-month interview. Note that 6,371 respondents were included in this research compared with the 5,301 included in the research by Underwood et al. (2017). [↑](#footnote-ref-33)
34. Scoring Procedure: Infant Behavior Questionnaire – Revised – Very Short Form obtained from Professor M. A. Gartstein Ph.D. February 2017. [↑](#footnote-ref-34)
35. Note that not all items were applicable to every child, so, as per the scoring procedure, only those items that were applicable were included in the mean score. [↑](#footnote-ref-35)
36. Note that the association of material hardship with other potential confounders has been described in section 4. [↑](#footnote-ref-36)
37. Note that because the constructed variable was not a true count due to categorisation in the GUiNZ data set Poisson regression was not considered suitable for this analysis. [↑](#footnote-ref-37)
38. Note that the potential confounding and mediating factors depicted in the diagram are not exhaustive, but reflect the major factors considered in the relationship between material hardship and the outcome. [↑](#footnote-ref-38)
39. As indicated from the results of the Item Response Theory, Exploratory Factor Analysis, Confirmatory Factor Analysis, measures of internal consistency and reliability and concurrent validity testing. Details are provided in section 2. [↑](#footnote-ref-39)
40. Statistics included the following. Chi-square: Deviance (df=#); LR (df=#); p-value. R2: McFadden; McFadden (adjusted); Cox-Snell/ML; Cragg-Uhler/Nagelkerke; Efron; Tjur's D. IC: AIC; AIC divided by N; BIC (df=#). [↑](#footnote-ref-40)