Social inequalities in childcare quality and their effects on children’s development

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Short Title: Inequalities in childcare

Abbreviations: CI = Confidence Interval, EMM= Effect Measure Modification, LSAC = Longitudinal Study of Australian Children, PPVT = Peabody Picture Vocabulary Test, RERI= Relative Excess due to Interaction, RR= Rate Ratio, SD = Standard Deviation, SDQ = Strengths and Difficulties Questionnaire, SII – Slope Index of Inequality, RII = Relative Index of Inequality

Keywords: child care; child behaviour; cognition; early childhood

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What’s known on this subject?
Higher-quality childcare during early childhood may have an important role in supporting low-income children’s school readiness but specific evidence is mixed.

What this study adds?
Higher-quality childcare, in terms of relationships with carers, was more strongly associated with better receptive vocabulary and fewer behavioural difficulties, among children from lower-income than higher-income families. Higher-quality relationships in childcare matters more for children from lower than higher-income backgrounds.
Contributors’ Statement:

Angela Gialamas: Ms Gialamas designed the study, contributed to the statistical framework, performed the analyses, interpreted the data, drafted the initial manuscript, and approved the final manuscript as submitted.

Murthy N. Mittinty: Dr Mittinty designed the statistical framework, contributed to the interpretation, reviewed the manuscript and approved the final manuscript as submitted.

Michael G. Sawyer: Prof Sawyer contributed to the interpretation, reviewed the manuscript and approved the final manuscript as submitted.

Stephen R. Zubrick: Prof Zubrick contributed to the interpretation, reviewed the manuscript and approved the final manuscript as submitted.

John Lynch: Prof Lynch designed the study and statistical framework, contributed to the interpretation, reviewed the manuscript and approved the final manuscript as submitted.
Abstract

Objective: To examine whether higher-quality childcare was associated with better developmental outcomes at school entry for children from lower than higher-income families.

Methods: The sample from the Longitudinal Study of Australian Children included children attending childcare from 2-3 years (n=980-1187, depending on outcome). Childcare quality was measured using carers assessment of their relationship with the child. Children’s receptive vocabulary was directly assessed in the child’s home, and behavioural difficulties were measured by questionnaire, by parents and teachers at 4-5 years. We measured absolute and relative quality-related inequalities, and investigated multiplicative and additive income-related effect measure modification of the quality of carer-child relationship on receptive vocabulary and behavioural difficulties at 4-5 years.

Results: Negligible inequalities in developmental outcomes between lower and higher-income groups were seen for children experiencing higher-quality relationships in childcare. After extensive adjustment for confounding, there was evidence for statistically significant multiplicative effect measure modification. Compared with children who experienced higher-quality relationships and higher-income, children with higher-quality relationships and lower-income had negligible risk of poorer receptive vocabulary (RR=1.05(95% CI: 0.86, 1.27), no increased risk of teacher-reported behavioural difficulties (RR=0.99(0.61, 1.57) and a slightly higher increased risk of parent-reported (RR=1.20(0.79, 1.84) behavioural difficulties.

Conclusion: The effects of higher-quality childcare, in terms of quality relationships with carers, on children’s cognitive and behavioural development at school entry were greater among children from lower-income families. Higher-quality relationships in formal childcare may be especially important in closing developmental gaps for children from lower-income families.
INTRODUCTION

Family income experienced before age five is strongly associated with children’s cognitive ability, behaviour and school readiness,¹ such that children from lower-income families are more likely to start school with poorer cognitive skills and more socio-emotional problems than their more affluent peers.², ³

Access to high-quality childcare may have an important role in promoting the development of young children and supporting children’s school readiness.⁴, ⁵ Childcare exposes children to educational resources and may help them learn skills and behaviours they require in school. Childcare quality is a multidimensional construct characterised by domains including the quality of the relationship between the carer and child, availability of age-appropriate activities and the level of education of carers.⁶, ⁷ Higher-quality childcare is positively associated with children’s cognitive and socio-emotional skills at school entry.⁸, ⁹ Higher-quality childcare may be particularly beneficial for lower-income children who may be more likely to experience less cognitively stimulating home environments and caregiving than children from higher-income families.¹⁰ However, the evidence is mixed as to whether higher-quality childcare is more important for children from lower-income backgrounds.⁶, ¹¹–¹³

Equitable access to high-quality childcare is an important policy issue for many countries because it is central to issues around workforce participation, especially for women, and promoting optimal child development. An associated policy issue is reducing disparities between the most and least advantaged socioeconomic groups.¹⁴ In the USA, most public resources for childcare are targeted to children from low-income families.¹⁵ In contrast, the Australian government assists with the costs of childcare for most families with no additional targeted support for low-income children.¹⁶ In Australia childcare centres and family day care services operate under a national quality improvement and accreditation system funded
by the federal government to promote high-quality care. Despite these policy commitments, children from low-income families remain more likely to experience poorer quality care than those from high-income families, yet it is they who are believed to gain the most. In the present study, our apriori hypothesis was that three domains (higher-quality relationships, activities and carer characteristics) of childcare quality would be associated with children’s development. However, from our previous research we observed that only one domain (the quality of carer-child relationships) was associated with children’s development. It is for this reason, the purpose of this study was to examine whether higher quality childcare in terms of the carer-child relationship on children’s receptive vocabulary and behavioural difficulties at school entry differed by income group i.e., whether higher-quality relationships between carer and child was more strongly associated with better outcomes for children from lower than higher-income families.

METHODS

Study Design

Data from the infant cohort of the Longitudinal Study of Australian Children (LSAC) was used in the present study. Sampling design, recruitment and data collection for LSAC have been reported elsewhere. Briefly, LSAC used a two-stage cluster sampling design. First, Australian postcodes were randomly sampled within strata for state/territory and urban/rural status to ensure that the sample was nationally representative. Second, children born March 2003-February 2004 within each postcode were randomly selected using Australia’s national Medicare database in which >90% of infants are enrolled. This method identified 8921 infants who were eligible to participate. Of these, 5107 infants were recruited into the study (response rate 57.2%). Our analyses use the first three waves of data when children were 0-1 (n=5107), 2-3 (n=4606) and 4-5 years (n=4386). The study was approved by the Australian Institute of Family Studies Ethics Committee.
Sample
For the present study, the sample included children aged 2-3 years attending formal childcare. Formal childcare refers to regulated, paid care away from the child’s home and included care in a childcare centre or family day care. At the face-to-face interview, the primary caregiver identified whether in the past month the study child was ‘looked after at regular times during the week by anyone other than the parent living in the home’. If the child spent eight or more hours/week in childcare, a questionnaire was posted to the main childcare provider to capture information about the childcare environment. There were 1859 (40% of the wave 2 sample) children in childcare for at least eight hours/week and whose primary caregiver consented for a questionnaire to be posted. This proportion is similar to national reports which show 54% of 2-3 year olds attending formal childcare. A total of 1282 questionnaires were returned (69% response rate).

Measures
Childcare quality
The quality of the carer-child relationship was derived using factor analysis from childcare provider questionnaire data. The quality of the carer-child relationship measured the perceived degree to which a childcare provider experienced affection, warmth and open communication with the child. The domain score for the quality of the carer-child relationship ranged from 8-16 where a higher score reflected higher-quality childcare. The carer-child relationship score was left skewed (mean score=14.9; median=16; interquartile range=15-16) with 55% of all participants achieving the maximum score of 16. Both continuous and dichotomized scores were examined in the analyses. Children were classified as receiving higher-quality if they scored a 1 (“low rating”) on less than three (out of eight) indicators, else were classified as receiving lower-quality. Further information concerning the measurement of relationship quality is provided in Supplemental Table 1.
Socioeconomic Position

In this study, annual household income was used as the indicator of socioeconomic position because it is the most relevant indicator for the ability to pay for higher-quality childcare. The income distribution was categorized as ≤$41,599/year (<$799/week=lower-income) and ≥$41,600/year (≥$799/week=higher-income). We chose these cutpoints as they were similar to national household income data, where the bottom 20% of Australians received less than $769/week, 40% received between $770–$1362/week, and 40% received over $1363/week.21

Developmental Outcomes

Children’s receptive vocabulary at 4-5 years was directly assessed in the child’s home using the Peabody Picture Vocabulary Test III (PPVT)–LSAC Australian Short Form.22 For estimating the risk of poorer development, we used the continuous PPVT score to construct a binary variable, with a score below the median used to define lower receptive vocabulary. While this dichotomization is arbitrary, we based this decision on the density of the PPVT score that showed a mixture of distributions. Dichotomizing the PPVT score at the median was considered to provide a meaningful representation of the variable (Supplemental Figure 1).

Children’s behavioural difficulties at 4-5 years were assessed by using the Strengths and Difficulties Questionnaire (SDQ), which was completed by primary caregivers and teachers. Informants used a three-point Likert scale to specify how 25 items for five sub-scales, prosocial, hyperactivity, emotional symptoms, conduct problems and peer problems of five items apply to the child.23 A total difficulties score was created by summing the scores from all the scales except the prosocial scale as it measures positive behaviour. Recommended cutpoints were used to identify children scoring in the “normal” “borderline” and “abnormal” range.23 We derived a binary variable based on the raw scores, with borderline and abnormal cutoff scores used to define behavioural difficulties.
Confounders

Confounding factors were identified apriori using a directed acyclic graph\textsuperscript{24} as being associated with childcare quality and children’s development. Covariates were measured at baseline (0-1 years) with the exception of variables representing the home environment that were measured when children were aged 2-3 years. These covariates included child age, sex, birthweight, parental concern about the child’s learning and development, primary caregivers age, highest educational qualification, work status, psychological distress using the Kessler 6\textsuperscript{25}, geographic remoteness using the Accessibility and Remoteness Index of Australia\textsuperscript{26}, whether the family experienced economic hardship over the last year, whether the child lived in a two-parent household, number of siblings, number of children’s books in the home, time spent reading to the child and whether the child undertook regular cost activities.

Multiple Imputation

To address attrition and item non-response, multiple imputation by chained equations was used to impute missing values.\textsuperscript{27} Imputed datasets were generated under the missing at random assumption that uses observed variables in the dataset to predict missingness and estimate parameters.\textsuperscript{28} The imputation was conducted for the full sample, however data were analysed only for children who had observed outcomes for receptive vocabulary (n=1187) and parent-(n=1092) and teacher-(n=980) reported SDQ scores.\textsuperscript{29} Twenty imputed datasets were generated and the results of the imputed analyses were combined using Rubin’s rules.\textsuperscript{30} All analyses were conducted using Stata version 12.1.

Analysis

Absolute and Relative Inequalities

To examine inequalities in the quality of the carer-child relationship and poorer receptive vocabulary and behavioural difficulties by income group, we computed the slope index of inequality (SII) and relative index of inequality (RII).\textsuperscript{31,32} The SII and RII are summary
measures of inequality interpreted as the absolute and relative differences in receptive vocabulary and behavioural difficulties between the lowest and highest classes of relationship quality. The SII takes a value of 0 and the RII a value of 1.0 if the proportion of children with poorer development is equal over levels of relationship quality. The computational process of constructing the SII and RII is provided in Supplemental Table 2.

**Effect Measure Modification**

Our apriori expectation was that higher-quality relationships in childcare would be more strongly associated with better outcomes for children from lower than higher-income backgrounds. In other words, we were interested in estimating the causal effect of the quality of the carer-child relationship (CCQ, 1=lower-quality, 0=higher-quality) and children’s receptive vocabulary (Y, 1= <median, 0= ≥ median) and behavioural difficulties (Y, 1= problems, 0= no problems) within the levels of income (1=lower income, 0= higher income). This measure is formally known as Effect Measure Modification (EMM). The formula for estimating EMM can be written as:

\[
\mu(E(Y_{ccq=1}|Income = i), E(Y_{ccq=0}|Income = i))
\]

where \( \mu \) is the risk ratio (RR) that varies across strata of income (\( i = 1,2,3 \)). For estimating risk we used the log link in generalized linear regression models, adjusting for all confounders. We can decompose the joint effect of CCQ and income into a component that is due to CCQ alone, or the effect due to income alone or, the effect due to their interaction. To test for EMM, we used both multiplicative and additive scales outlined by Knol and VanderWeele. It has been recommended that both multiplicative and additive interaction terms be presented to provide readers with sufficient information to draw conclusions about the size and statistical significance of the EMM. Multiplicative interaction was examined through a cross-product interaction term in the regression model and additive interaction was examined using the relative excess risk due to interaction (RERI). RERI represents the risk
that is in excess of what would be expected if the combination of relationship quality and income was entirely additive. In the absence of additive interaction, RERI is equal to 0. In the absence of multiplicative interaction the ratio of risk equals 1. The 95% confidence intervals were derived using the standard delta method.36

RESULTS

Table 1 describes the characteristics of the study participants. The majority of children lived in a family with an annual household income ≥$41,600 (~76%). A total of 509 (43%) children had a receptive vocabulary score below the median, 160 (15%) and 162 (16%) children had parent and teacher-reported behavioural difficulties.

As a first step in estimating the potential effect of the quality of the carer-child relationship on children’s development by income group we considered the SII and RII. As shown in Figure 1, 89% of children in the lower-income group experiencing the lowest quality of carer-child relationship had a receptive vocabulary score < median. On the other hand, the gap in performance between the lower and higher-income groups experiencing the highest quality of care was negligible (39% versus 36% respectively). The pattern of results was similar for parent- and teacher-reported behavioral difficulties (see Supplemental Figures 2-3).

The second step in our analyses was to examine whether the effect of higher-quality relationships in childcare on children’s receptive vocabulary and behavioral difficulties was moderated by income level, adjusting for confounding. As shown in Tables 2-4, there was no evidence to suggest that the estimated effect on the additive scale of lower-quality carer-child relationships with lower-income was larger than the estimated effect of lower-quality carer-child relationships with higher-income. On the contrary, for the multiplicative scale, income modified the association between the quality of carer-child relationship and children’s receptive vocabulary and behavioral difficulties. As shown in Table 2, compared with
children who experienced higher-quality carer-child relationships and higher-income, children with higher-quality relationships and lower-income had a negligible risk of a receptive vocabulary score < median (RR=1.05 (95% CI: 0.86, 1.27). Similarly, as shown in Tables 3-4, children experiencing higher-quality relationships and lower-income had no increased risk of teacher-reported behavioural difficulties (RR=0.99 (0.61, 1.57) and a slightly higher increased risk of parent-reported (RR=1.20 (0.79, 1.84) behavioural difficulties.

DISCUSSION

In this large, nationally representative cohort of Australian children we found that higher-quality relationships in childcare had a striking effect on lower-income children’s development at school entry. Our findings suggest that the gap in performance between the lower and higher-income groups experiencing the highest quality of care was small, highlighting the positive contribution higher-quality relationships in childcare has for children from lower-income backgrounds. Even after adjustment for an extensive range of confounding factors, the EMM analyses between the quality of the carer-child relationship and income confirmed that higher-quality relationships acted as a protective factor for lower-income children.

Whilst these results are encouraging, it is important to consider the measurement of childcare quality when interpreting these findings. Our measure utilized carers self-report of their perceived relationship with the child that may have resulted in an over-estimation of quality. For example, in our study 55% of children achieved the maximum quality score. On the other hand, the high-quality reported by carers may reflect the regulatory context of childcare in Australia\textsuperscript{17}, which strives for universal access to high-quality care. Although there were no nationally consistent Australian childcare regulations when the present study commenced in 2004, the quality assurance and accreditation system managed by the National Child Care Accreditation Council was designed to operate in conjunction with state and territory
licensing regulations, with most services (98%) complying with the standards. Yet even in a country that sees most formal childcare services operating under a regulatory environment, results from this study indicate inequalities in the quality of relationships in childcare that had a pronounced effect on lower-income children’s development at school entry. The targeting of additional support for children from lower-income families has been overlooked in the Australian context, however; results from this study suggest this may require policy attention.

Our finding that higher-quality relationships among lower-income children buffer the effect of poorer developmental outcomes at school entry is consistent with a longitudinal study of childcare from the USA. Dearing et al using a global measure of childcare quality that summed a number of quality domains including carer sensitivity and responsiveness to a child, found higher-quality care protective of children in low-income families, supporting their school readiness (e.g. letter identification). As this earlier study was not nationally representative with participating families having higher incomes, more education and less likely to be of a minority group than the general population the present study using a representative sample of children strengthens this finding. Furthermore, our results provide specific information regarding the mechanism through which childcare may protect or put children at risk which can then be used for interventions, such as those targeting carer-child relationships to enhance the quality of childcare programs and in turn improve the developmental outcomes of children.

The present findings should be interpreted within the context of the study limitations. As noted earlier, our measure of childcare quality was based on carer-report that may have resulted in an overestimation of quality. However, no single measure is currently accepted as a gold standard. Strengths of the present study include its use of multiple informants’ reports to assess children’s development, the use of a large, nationally representative sample of
children and the ability to adjust for a large number of confounders. Furthermore, to our knowledge, this is the first study to have investigated the joint effect as well as the moderation effect of childcare quality and income on children’s development thus advancing existing research in this area.

CONCLUSION

High-quality childcare during children’s preschool years may have an important role in closing developmental gaps between social classes.5, 14 Our results showed that at the highest quality of relationships in childcare there was little difference in developmental outcomes between the lower and higher-income groups supporting the concept that high-quality childcare helps children from low-income families reach a more equal start at school entry. In light of the increasing demand for high-quality childcare and its potential role in reducing socioeconomic disparities in cognitive and socio-emotional abilities at school entry the results from this study may have important implications for practice and public policy efforts.
ACKNOWLEDGEMENTS
This paper used confidentialised unit record files from LSAC. The LSAC project is conducted in partnership between the Commonwealth Department of Families, Community Services and Indigenous Affairs (FaHCSIA), the Australian Institute of Family Studies (AIFS) and the Australian Bureau of Statistics (ABS). The findings and views in this paper are those of the authors and should not be attributed to FaHCSIA, AIFS or ABS.
REFERENCES


Table 1: Summary Characteristics of Study Participants using the multiply imputed sample

<table>
<thead>
<tr>
<th></th>
<th>Receptive Vocabulary (n=1187)</th>
<th>Parent-Reported Difficulties (n=1092)</th>
<th>Teacher-Reported Difficulties (n=980)</th>
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</thead>
<tbody>
<tr>
<td>Child age, mean(SD)</td>
<td>57.7 (2.7)</td>
<td>57.7 (2.7)</td>
<td>57.7 (2.7)</td>
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<tr>
<td>Birth weight (grams)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;=2500</td>
<td>54 (4.5)</td>
<td>50 (4.6)</td>
<td>43 (4.4)</td>
</tr>
<tr>
<td>&gt;=2501</td>
<td>1133 (95.5)</td>
<td>1042 (95.4)</td>
<td>937 (95.6)</td>
</tr>
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<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>570 (48.0)</td>
<td>510 (46.7)</td>
<td>461 (47.0)</td>
</tr>
<tr>
<td>Male</td>
<td>617 (52.0)</td>
<td>582 (53.3)</td>
<td>519 (53.0)</td>
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<td>Concerns about child’s learning and development</td>
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<td></td>
<td></td>
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<td>Yes a little/Don’t know</td>
<td>71 (6.0)</td>
<td>69 (6.3)</td>
<td>65 (6.6)</td>
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<td>No</td>
<td>1116 (94.0)</td>
<td>1023 (93.7)</td>
<td>915 (93.4)</td>
</tr>
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<td>Parent age (years), mean(SD)</td>
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<td>31.9 (5.1)</td>
<td>31.9 (5.0)</td>
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<td>Kessler 6 score, mean(SD)</td>
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<td>4.41 (.55)</td>
<td>4.42 (.55)</td>
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<td>Annual household income</td>
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<td>≤$41,599</td>
<td>282 (23.8)</td>
<td>250 (22.9)</td>
<td>224 (22.9)</td>
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<td>≥$41,600</td>
<td>905 (76.2)</td>
<td>842 (77.1)</td>
<td>756 (77.1)</td>
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<td>Remoteness Index</td>
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<tr>
<td>Highly accessible</td>
<td>670 (56.4)</td>
<td>612 (56.0)</td>
<td>556 (56.7)</td>
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<td>Other</td>
<td>517 (43.6)</td>
<td>480 (44.0)</td>
<td>424 (43.3)</td>
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<td>Primary caregiver education</td>
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<td>&lt; Bachelor degree</td>
<td>725 (61.1)</td>
<td>655 (60.0)</td>
<td>582 (59.4)</td>
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<td>Bachelor degree or higher</td>
<td>462 (38.9)</td>
<td>437 (40.0)</td>
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<td>Primary caregiver work status</td>
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<td>Fulltime work</td>
<td>186 (15.7)</td>
<td>173 (15.8)</td>
<td>158 (16.1)</td>
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<td>Part time work</td>
<td>448 (37.7)</td>
<td>424 (38.8)</td>
<td>381 (38.9)</td>
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<tr>
<td>Not in labour force</td>
<td>553 (46.6)</td>
<td>495 (45.3)</td>
<td>441 (45.0)</td>
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<td>Economic hardship</td>
<td></td>
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<td>No significant hardship</td>
<td>665 (56.0)</td>
<td>620 (56.8)</td>
<td>570 (58.2)</td>
</tr>
<tr>
<td>Some significant hardship</td>
<td>522 (44.0)</td>
<td>472 (43.2)</td>
<td>410 (41.8)</td>
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<td>Two parent household</td>
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<tr>
<td>No</td>
<td>91 (7.7)</td>
<td>84 (7.7)</td>
<td>66 (6.7)</td>
</tr>
<tr>
<td>Yes</td>
<td>1096 (92.3)</td>
<td>1008 (92.3)</td>
<td>914 (93.3)</td>
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<tr>
<td>Number of siblings</td>
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<td>0</td>
<td>483 (40.7)</td>
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<td>1</td>
<td>488 (41.1)</td>
<td>454 (41.6)</td>
<td>406 (41.4)</td>
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<td>≥ 2</td>
<td>216 (18.2)</td>
<td>195 (17.9)</td>
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<td>Children’s books in the home</td>
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<td></td>
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<tr>
<td>≤ 20 books</td>
<td>145 (12.2)</td>
<td>125 (11.5)</td>
<td>107 (10.9)</td>
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<tr>
<td>≥ 21 books</td>
<td>1042 (87.8)</td>
<td>967 (88.5)</td>
<td>873 (89.1)</td>
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<tr>
<td>Minutes child usually read to</td>
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<tr>
<td>≤ 20 minutes</td>
<td>1061 (89.4)</td>
<td>973 (89.1)</td>
<td>874 (89.2)</td>
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<tr>
<td>≥ 21 minutes</td>
<td>126 (10.6)</td>
<td>119 (10.9)</td>
<td>106 (10.8)</td>
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### Receptive Vocabulary (n=1187) vs Parent-Reported Difficulties (n=1092) vs Teacher-Reported Difficulties (n=980)

<table>
<thead>
<tr>
<th>Category</th>
<th>Receptive Vocabulary (n=1187)</th>
<th>Parent-Reported Difficulties (n=1092)</th>
<th>Teacher-Reported Difficulties (n=980)</th>
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<tr>
<td>Regular or extra cost activities</td>
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<tr>
<td>No</td>
<td>639 (53.8)</td>
<td>580 (53.1)</td>
<td>515 (52.6)</td>
</tr>
<tr>
<td>Yes</td>
<td>548 (46.2)</td>
<td>512 (46.9)</td>
<td>465 (47.5)</td>
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<td>Quality of carer-child relationship</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Higher-quality</td>
<td>1011 (85.2)</td>
<td>923 (84.5)</td>
<td>825 (84.2)</td>
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<td>Lower-quality</td>
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<td>169 (15.5)</td>
<td>155 (15.8)</td>
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<td>PPVT score</td>
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<tr>
<td>PPVT ≥ median</td>
<td>678 (57.1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PPVT &lt; median</td>
<td>509 (42.9)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Parent-Reported Difficulties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Problems</td>
<td>-</td>
<td>932 (85.4)</td>
<td>-</td>
</tr>
<tr>
<td>Problems</td>
<td>-</td>
<td>160 (14.7)</td>
<td>-</td>
</tr>
<tr>
<td>Teacher-Reported Difficulties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Problems</td>
<td>-</td>
<td>-</td>
<td>818 (83.5)</td>
</tr>
<tr>
<td>Problems</td>
<td>-</td>
<td>-</td>
<td>162 (16.5)</td>
</tr>
</tbody>
</table>

Data are presented as N (%) except as noted
PPVT = Peabody Picture Vocabulary Test
Table 2: Receptive vocabulary (PPVT): Formal analysis of effect measure modification of the quality of carer-child relationship by income group

<table>
<thead>
<tr>
<th></th>
<th>Higher quality carer-child relationship</th>
<th>Lower quality carer-child relationship</th>
<th>RR (95% CI) for lower vs. higher quality of carer-child relationship within strata of income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N &lt;median/≥median PPVT</td>
<td>N &lt;median/≥median PPVT</td>
<td></td>
</tr>
<tr>
<td>Higher Income</td>
<td>305/493</td>
<td>58/49</td>
<td>1.33 (1.09, 1.62) p=0.004</td>
</tr>
<tr>
<td>Lower Income</td>
<td>97/116</td>
<td>49/20</td>
<td>1.46 (1.18, 1.82) p=&lt;0.001</td>
</tr>
</tbody>
</table>

Measure for effect measure modification on an additive scale: RERI= 0.16 (-.20, .52) p=0.39
Measure for effect measure modification on a multiplicative scale: Ratio of RRs= 1.11 (.79, 1.43) p=<0.001
RRs are adjusted for child age, sex, birth weight, parental concern about child’s learning and development, primary caregiver age, education, work status, Kessler 6 score, economic hardship, geographic remoteness, two parent household, number of siblings, number of children’s books, minutes child usually read to, regular or extra cost activities

Table 3: Parent-reported behavioural difficulties (SDQ): Formal analysis of effect measure modification of the quality of carer-child relationship by income group

<table>
<thead>
<tr>
<th></th>
<th>Higher quality carer-child relationship</th>
<th>Lower quality carer-child relationship</th>
<th>RR (95% CI) for lower vs. higher quality of carer-child relationship within strata of income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Problems/No Problems</td>
<td>N Problems/No Problems</td>
<td></td>
</tr>
<tr>
<td>Higher Income</td>
<td>85/651</td>
<td>18/88</td>
<td>1.26 (.79, 2.01) p=0.31</td>
</tr>
<tr>
<td>Lower Income</td>
<td>34/153</td>
<td>23/40</td>
<td>1.64 (1.04, 2.58) p=0.03</td>
</tr>
</tbody>
</table>

Measure for effect measure modification on an additive scale: RERI= 0.56 (-.43, 1.55) p=0.26
Measure for effect measure modification on a multiplicative scale: Ratio of RRs= 1.31 (.47, 2.16) p=0.002
RRs are adjusted for child age, sex, birth weight, parental concern about child’s learning and development, primary caregiver age, education, work status, Kessler 6 score, economic hardship, geographic remoteness, two parent household, number of siblings, number of children’s books, minutes child usually read to, regular or extra cost activities

Table 4: Teacher-reported behavioural difficulties (SDQ): Formal analysis of effect measure modification of the quality of carer-child relationship by income group

<table>
<thead>
<tr>
<th>Income</th>
<th>Higher quality carer-child relationship</th>
<th>Lower quality carer-child relationship</th>
<th>RR (95% CI) for lower vs. higher quality of carer-child relationship within strata of income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Problems/ No Problems</td>
<td>RR (95% CI)</td>
<td>N Problems/ No Problems</td>
</tr>
<tr>
<td>Higher Income</td>
<td>81/580</td>
<td>1.0</td>
<td>26/69</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Income</td>
<td>27/137</td>
<td>.99 (.61, 1.57)</td>
<td>28/32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>p=0.95</td>
<td></td>
</tr>
</tbody>
</table>

Measure for effect measure modification on an additive scale: RERI= .35 (-.74, 1.44) p=0.53
Measure for effect measure modification on a multiplicative scale: Ratio of RRs= 1.17 (.47, 1.87) p=<0.001

RRs are adjusted for child age, sex, birth weight, parental concern about child’s learning and development, primary caregiver age, education, work status, Kessler 6 score, economic hardship, geographic remoteness, two parent household, number of siblings, number of children’s books, minutes child usually read to, regular or extra cost activities
Figure 1: Inequalities in the quality of the carer-child relationship and proportion of children with a receptive vocabulary score < median by income group

*Due to small numbers in the lowest quality of carer-child relationship, we combined scores 8-11 into a single category for the analysis