

**Child poverty and children entering care: a natural experiment using longitudinal area-level data in England, 2015-2020.**

*Davara L Bennett<sup>1</sup> MSc, Daniela K Schlüter<sup>1</sup> PhD, Gabriella Melis<sup>1</sup> PhD, Paul Bywaters<sup>2</sup> MA, Ben Barr<sup>1</sup> PhD, Sophie Wickham<sup>1</sup> PhD, David Taylor-Robinson<sup>1\*</sup> PhD*

1. University of Liverpool, Department of Public Health, Policy and Systems.
2. Centre for Applied Childhood, Youth, and Family Research, Huddersfield University

Correspondence to: Davara L Bennett, University of Liverpool, Waterhouse Building 2nd Floor Block F, L69 3GL, Liverpool, United Kingdom. Email:

[davara.bennett@liverpool.ac.uk](mailto:davara.bennett@liverpool.ac.uk)

Telephone: 07508455861

**Contributorship statement**

DB is lead author and guarantor. DT-R is senior author. DB, DT-R and BB conceived of the study. DB planned the analysis and acquired the data. DB conducted the analysis, with support from all authors. DS verified the underlying data. DB led the drafting and revision of the manuscript; all authors reviewed and revised drafts and approved the final version for submission. We confirm that authors have no conflicts of interest to disclose.

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**Summary**

**Background.** Children in care face adverse health outcomes through the life-course, relative to their peers. In England, over the past decade, the stark rise in their number has coincided with rising child poverty, a key risk factor for children entering care. Our aim in this study was to assess the contribution of recent trends in child poverty to trends in care entry.

**Methods.** In this longitudinal ecological study of 147 local authorities between 2015 and 2020, we linked data from the Department for Work and Pensions and HM Revenue & Customs on the proportion of children under 16 living in families with income less than 60% median income, with Department for Education data on rates of children under 16 entering care. Using within-between regression models, and controlling for employment trends, we estimated the contribution of changing child poverty rates to changing care entry rates within areas.

**Findings.** Between 2015 and 2020 and controlling for employment rates, a 1% increase in child poverty was associated with 5 additional children entering care per 100,000 [95% CI 2–8]. We estimate that, over the study period, 8.1% [95% CI 5.0%–11.3%] of care entries were linked to rising child poverty, equivalent to 10,356 [95% CI 6,443–14,579] additional children.

**Interpretation.** This study offers evidence that rising child poverty rates are contributing to an increase in children entering care. Children's exposure to poverty creates and compounds adversity, driving poor health and social outcomes in later life. National anti-poverty policies are key to tackling adverse trends in care entry in England.

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**Research in context****Evidence before this study**

We searched databases including MEDLINE, CINAHL, PsycINFO, Scopus, and Web of Science, up to 3rd November 2021, using combinations of search terms including “poverty”, “abuse”, “neglect”, “looked after”, and synonyms. We hand-searched reference lists of relevant papers and restricted our search to publications in English. We also searched for systematic reviews of the impact of child poverty on children, irrespective of the outcomes of interest.

There is strong evidence, both at household and local area level, of a marked, graded association between poor socioeconomic conditions and a range of child welfare outcomes, from children’s experiences of adversity, including abuse and neglect, to coming into contact with child protection systems and entering care. Emerging evidence from US-based natural experiments point to poverty as a contributory causal factor in these outcomes. Comparable robust evidence from the UK is largely absent. A 2016 evidence review concludes that there has been “no comprehensive, large-scale, representative survey of the socio-economic circumstances of children subject to abuse and neglect in any of the UK countries or the UK as a whole.” This is reflected in the policy discourse in the UK. There is little formal recognition of the role of changing child poverty in determining outcomes for children. However, a recent international systematic review of the causal impact of household income identifies positive relationships with maternal mental health and the home environment, known risk factors for children’s social care involvement.

**Added value of this study**

This study contributes to the evidence base in England. It is, to our knowledge, the first study to use longitudinal, routinely available data for the whole of England to assess whether places that saw a greater rise in child poverty rates between 2015 and 2020 also saw a greater rise in the rate of children under 16 entering care. Using within-between regression models, which incorporate the strengths of both fixed and mixed effects approaches, we determine that, over the study period, a 1% increase in child poverty rates was associated with an additional 5 children entering care per 100,000 [2, 8], in the same year.

**Implications of all the available evidence**

In England, as in the US, the evidence is that shocks to families' household income affects children's experiences of adversity and their outcomes of interactions with child protection systems. Policies in the UK restricting the eligibility and generosity of welfare benefits may have contributed to rising rates of costly and acute out-of-home care interventions, deepening place-based inequalities in health and wellbeing. The consequences for local authority finances extend beyond children's social care to restrict funding for other health-promoting place-based public services. This study suggests that local authorities should embed poverty-informed policies in Children's Services and beyond. But national welfare policies are ultimately key to shifting population-level exposure to child poverty, an important socioeconomic determinant of care entry.

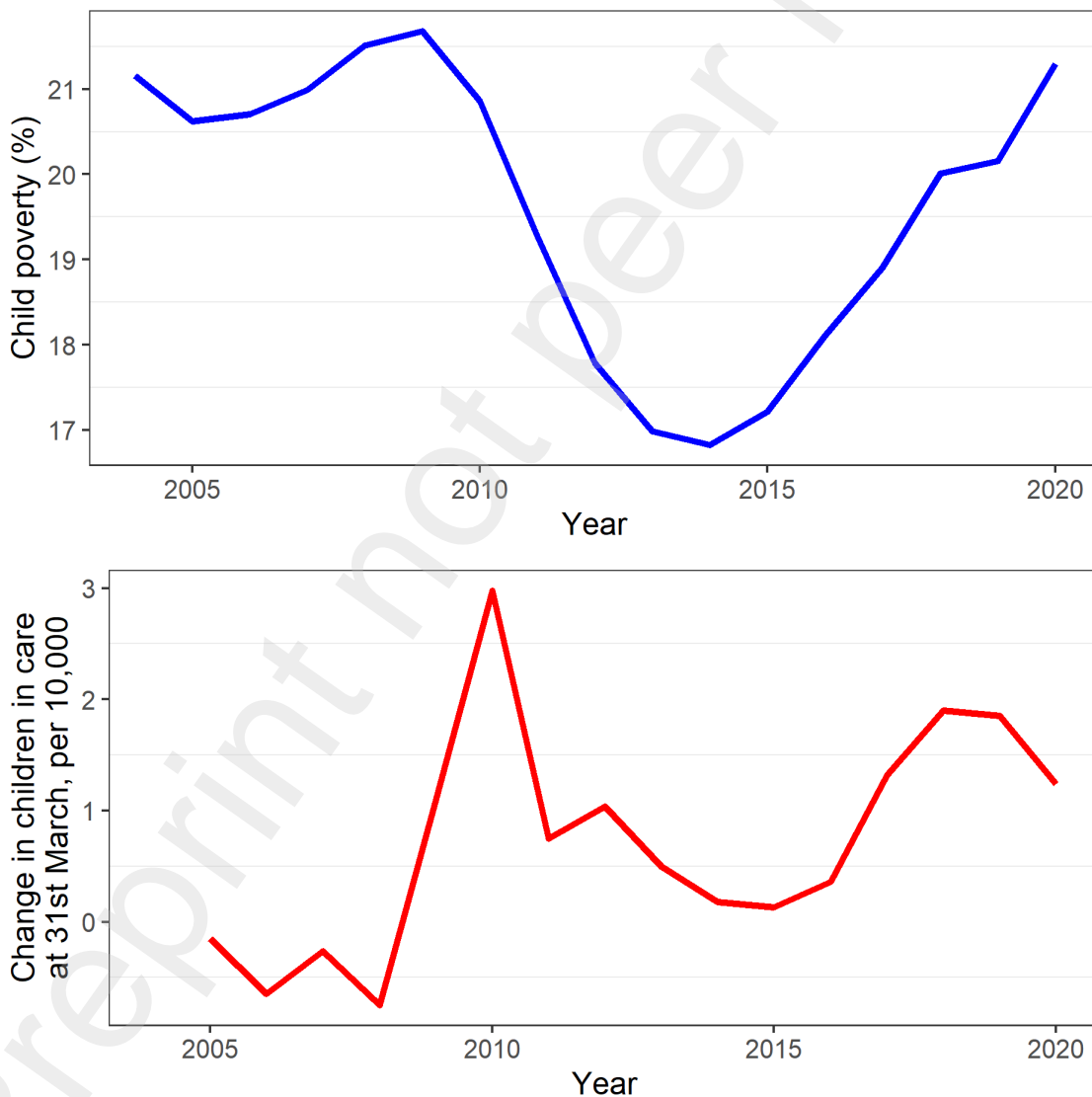
**Introduction**

There has been a steep rise in the rate of children in State care in England, from a low of 53 per 10,000 in 2008, to 67 per 10,000 in 2020 – a rise of 26%.<sup>1</sup> Widespread recognition of the poor health and social outcomes for these children,<sup>2</sup> together with concerns about the long-term financial health of local authorities entrusted with their care,<sup>3</sup> have precipitated research into likely drivers of the rise.<sup>4,5</sup> Child poverty emerges as a key risk factor. Our analysis of trends in care entry in England shows that the rise in rates was greater in poorer areas, increasing inequalities.<sup>6</sup> This raises important questions about the role of changing socioeconomic conditions (SECs) in shaping care entry. Figure 1 illustrates trends in the child poverty rate and in the annual change in the point prevalence of children in care. There is an echo between the trends.

Over the past two decades, across the UK, child poverty rates have fallen and risen again. At the turn of the millennium, a national government pledge to end child poverty by 2020 galvanised anti-poverty efforts.<sup>7</sup> Changes to the tax and welfare benefit system, and the introduction of a national minimum wage, affected, in particular, families with children.<sup>7,8</sup> Between 1998 and 2005, the percentage of children in relative poverty – living in households earning below 60% of the median income – declined from 27% to 21%, with a smaller dip between 2008 and 2014, from 22% to 18%. The latter dip was largely driven by a fall in median incomes as a result of the 2008 recession, rather than rising incomes for the least

well-off.<sup>9</sup> But the recession paved the way for a vastly altered policy landscape. Child poverty targets were abandoned. Income-based child poverty data narrowly survived a move to end their collection.<sup>10</sup> At the same time, between 2011 and 2018, 57 separate changes and cuts to welfare benefits restricted their generosity and eligibility, disproportionately affecting families with children.<sup>11</sup> These cuts were subsequently folded into universal credit, with its added constraints.<sup>11</sup> From 2014, child poverty rates began to rise and in 2020 reached 23%; after housing costs, this rises to 31%.<sup>12</sup> A 2019 Resolution Foundation report projects a rise to 37% by 2024.<sup>13</sup>

Figure 1. National trends in child poverty rates and change in rates of children in care at 31st March, per 10,000, in England. Relative child poverty before housing costs data are taken from Households Below Average Income statistics, and represent three-year right-aligned rolling averages.



While the rising national child poverty rate is well documented, the geographical pattern of the change is less well understood. New small-area income-based child poverty data were recently given official status.<sup>14</sup> Published by the Department for Work and Pensions (DWP) and HM Revenue & Customs (HMRC) and spanning five years from 2015 to 2020, they offer reliable estimates of child poverty at local authority level, and highlight the vast inequalities across England. In 2020, before housing costs, Middlesbrough was contending child poverty rates of 39%, compared with 7% in Richmond Upon Thames.<sup>14</sup>

Inequalities in child poverty may beget inequalities in children's wellbeing and child protection outcomes. There is strong evidence of an association between adverse SECs and childhood adversities, including abuse and neglect and subsequent care entry.<sup>15</sup> Bywaters et al.'s 2016 evidence review characterises poverty as a contributory causal factor in the aetiology of child abuse and neglect.<sup>15</sup> There is growing evidence from the US that raising the income of families in poverty leads to a reduction in reported or substantiated child maltreatment rates.<sup>15,16</sup> Taken by itself, however, the UK evidence is less robust.<sup>15</sup> Although many UK studies report a link between SECs and child protection intervention rates, poor quality routine data, limited statistical analyses and the dearth of more up-to-date studies, may obscure the strength of the broader evidence base, and hinder policy action.<sup>15</sup> The socioeconomic determinants of children's safety and wellbeing cut across borders; cross-country comparisons reveal important commonalities.<sup>17</sup> But policymakers favour, or may less easily dismiss, research that is attuned to local context and institutions.<sup>18</sup> The diversity of child protections systems stacks the challenge.

The differential rise in child poverty across England as a consequences of changing welfare policies opens up the possibility of evaluating the impact on vulnerable children, and the places where they live, as a natural policy experiment. Our aim in this study is to assess the relationship between child poverty and care entry. A secondary aim is to assess the relationship between child poverty and less acute statutory interventions: children made subject to a child protection plan, considered to be suffering, or likely to suffer, significant harm;<sup>19</sup> and children beginning an episode of need, deemed unlikely to achieve or maintain a reasonable standard of health and development without local authority support.<sup>20</sup>

## **Methods**

### *Data sources and measures*

We conducted a longitudinal study at local authority level in England using panel data from 147 English upper-tier local authorities between 2015 and 2020 – we refer to the financial year (April to March) by the latter year throughout. These data take us to the very brink of the first UK lockdown (March 2020) and are unaffected by the changes that followed. Four local authorities were excluded from our analyses: the City of London and the Isles of Scilly due to their small population size; Bournemouth, Christchurch and Poole and Dorset due to boundary changes that could not be reconciled across years.

Our primary outcome was the annual rate of children under the age of 16 starting to be looked after by local authorities in England (CLA rate, see textbox 1). Data were sourced from the ‘children looked after data return’.<sup>1</sup> For reasons of confidentiality, counts between one and five inclusive were suppressed in these data. We therefore randomly imputed an integer in this range.

Secondary outcomes included: the annual rate of children under the age of 18 subjected to a child protection plan (CPP rate), drawn from the ‘children in need’ census;<sup>21</sup> and the annual rate of children under the age of 16 beginning an episode of need (CIN rate), supplied by the Department for Education following a Freedom of Information Request.<sup>22</sup> Due to data suppression practices,

complete data for the restricted under-16 age group could not be obtained for children subjected to a child protection plan. Estimates for the total population of children under the age of 16 and 18 were derived from Office for National Statistics (ONS) mid-year population estimates.<sup>23</sup>

Our main exposure was the proportion of children under the age of 16 living in relative poverty, before housing costs. The relative poverty measure encompasses children living in families with an income less than 60% of the median income.<sup>14</sup> Income is defined as gross personal income from welfare benefits, tax credits, employment, self-employment, or occupational pension, and children are identified from HMRC Child Benefit scans.<sup>14</sup>

**Textbox 1. Definition of a Child Looked After<sup>1</sup>**

In England, a ‘Child Looked After’ designation refers to a child whose care has been transferred to the local authority, usually from their birth parents following a child protection investigation. These children are typically accommodated in foster or residential homes. If a child goes on to be adopted, they are no longer considered ‘looked-after’; if they return home, they may cease to be ‘looked-after’.

In analyses, we controlled for trends in employment using Labour Force Survey data on local authority-level employment rates for the working age population between 2015 and 2020.<sup>24</sup>

### *Statistical analyses*

We first used scatter plots to visualise, within each local authority, the association between the absolute change in the child poverty rate, and the absolute change in the CLA rate, between 2015 and 2020. To visually assess the distribution of changes across England, we mapped changes in exposure and outcome.

Using linear within-between regression models – hybrid models that retain the strengths of both traditional random and fixed effects approaches<sup>25</sup> – we then estimated the association between changes in child poverty and changes in the CLA rate within areas (for model formula, see appendix 2). These models allow us to control for time-invariant differences between areas, and national trends affecting all areas equally; we accounted for the correlation of observations within areas by including random intercepts.<sup>26</sup> We controlled for employment rates, a potential confounder of the association between exposure and outcome. The final model was used to estimate the contribution of trends in child poverty to trends in CLA rates. To gauge the practical significance of this contribution, we estimated the marginal difference between observed trends in CLA rates, and trends that might have been expected had child poverty rates from 2015 remained stable, employment trends unaltered. We estimated the financial costs associated with this difference (appendix 1).

The analysis was repeated for each of our secondary outcomes, CPP and CIN rates. We also conducted robustness tests, using alternative measures of the exposure and modelling approaches (appendix 3). All models were estimated using the “lme4” package, in R version 4.0.1.<sup>27</sup>

### *Role of the funding source*

The funders of the study had no role in study design, data collection, data analysis, data interpretation, the writing of the report, or the decision to submit the paper for publication.

### **Main results**

Summary statistics are presented in appendix 4. Our exploratory scatter plots in figure 2 show positive associations between the change in the proportion of children living in relative poverty before housing costs, and the change in each of our outcomes, within local



authorities, between 2015 and 2020. The maps in figure 3 illustrate the geographical distribution of changes in child poverty and care entry rates over the time period. They highlight a double burden of rising rates in the North-East of England, but also in parts of the North-West, the Midlands, and some coastal areas.

Figure 2. Associations between the change in the child poverty rate between 2015 and 2020, and intervention rates for each of our outcomes between 2015 and 2020, in each local authority, with 95% confidence intervals.

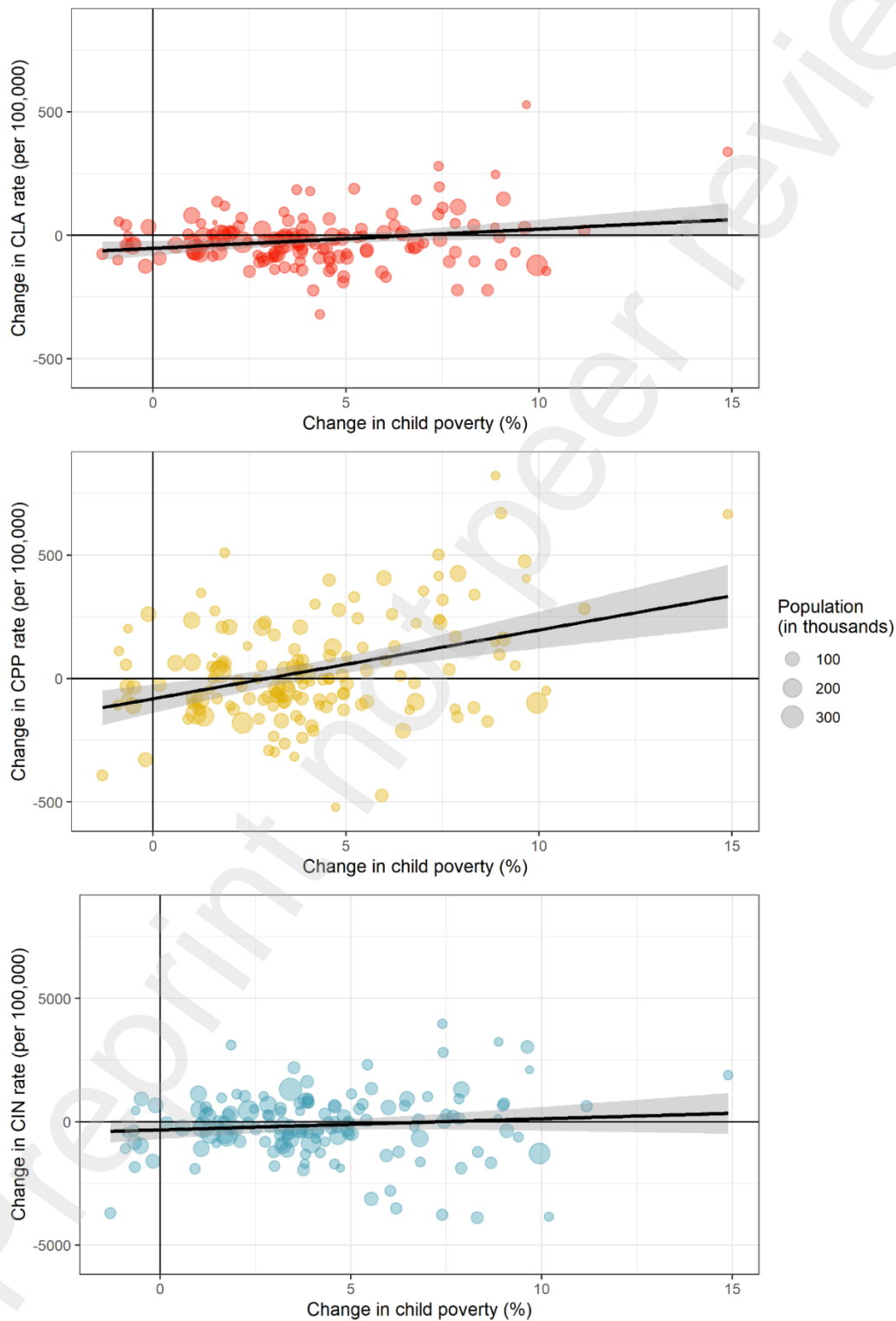
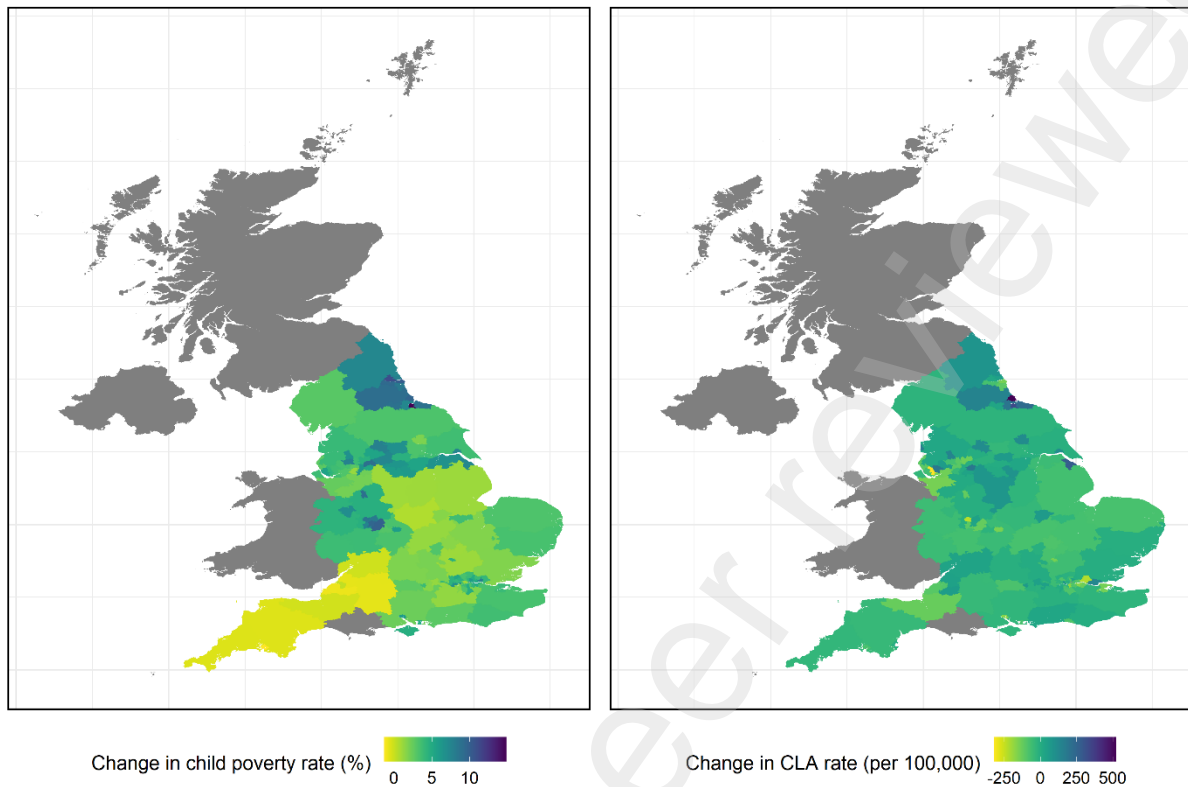


Figure 3. Maps of England showing the change in the child poverty rate, and the change in care entry rates, between 2015 and 2020



Our models affirm these findings – model estimates are summarised in table 1. Our main model shows that, between 2015 and 2020, within English local authorities and after controlling for employment rates, a 1% increase in the child poverty rate was associated with an additional 5 per 100,000 children entering care in the same year [95% CI 2–8]. We estimate that 10,356 additional children became looked after over the time period than would have been expected had 2015 child poverty levels remained constant [95% CI 6,443–14,579]. This is equivalent to 8.1% of the total number of children under the age of 16 entering care over the period [95% CI 5.0%–11.3%], at an estimated cost of £1.4 billion [95% CI £0.8–£2.0].

*Table 1. Summary of regression coefficients for the within-area change in our primary and secondary outcomes associated with a change in the child poverty rate (see appendix 5 for a summary of the between-area change and appendix 6 for complete model output showing all regression coefficients); and change in the number of children experiencing each outcome associated with the rise in child poverty, 2015-20, employment trends unaltered.*

	Annual change in the rate per 100,000 for a 1% increase in child poverty, controlling for employment rates [95% CI]	Estimated additional number of children associated with rising child poverty rates, 2015-20, employment trends unaltered [95% CI]
Children starting to be looked after	5.2 [2.2, 8.3]	10,356 [6,443,14,579]
Children made subject to a child protection plan	19.0 [12.3, 25.8]	21,987 [14,269, 29,621]
Children beginning an episode of need	52.2 [13.6, 90.8]	51,736 [15,352–89,021]

Identical models for our secondary outcomes show that, over the same time period, a 1% increase in the child poverty rate was associated with rising intervention rates across the board: an additional 19 per 100,000 children made subject to a child protection plan [95% CI 12–26]; and an additional 52 per 100,000 children beginning an episode of need [14–91], controlling for employment rates. We estimate that, between 2015 and 2020, 6.7% of all new child protection plans [95% 4.4%–9.1% CI] and 3.2% [95% CI 1.0%–5.5%] of episode of need, were due to the rise in child poverty from 2015.

The results of our checks and robustness tests validate our main findings (appendix 3). In our main models, across all outcomes, the association with child poverty was evident across time and place, both within local authorities over time, and between local authorities on average (appendix 5). For our two more acute outcomes, care entry and child protection plan initiation, the association was robust to the specification of poverty type (appendix 7 table 1). Alternative modelling approaches yielded comparable findings (appendix 7 table 2). For our less acute child in need intervention however, the use of after-housing-cost child poverty data nullified the within-area association for this outcome; using alternative modelling approaches, we found no evidence of a between-area association. Our findings for this outcome are therefore more tentative.

## Discussion

Between 2015 and 2020, across England, after controlling for employment rates, local authorities that saw a greater rise in child poverty experienced greater increases in the rate of children entering care, the most drastic State intervention into the lives of children and families. These same local authorities also experienced greater increases in rates of children becoming subject to a child protection plan and beginning an episode of need. The changes

are substantive. We estimate that the rise in child poverty from 2015, largely the consequence of cuts to welfare benefits,<sup>11</sup> was associated with an additional 10,356 children entering care; 21,987 children being placed on a child protection plan, and 51,736 children beginning an episode of need, between 2015 and 2020. These increases have disproportionately affected more deprived local authorities less able to manage them, deepening inequalities.

Our analysis adds to growing evidence of the contributory causal nature of the relationship between child poverty and children's social care involvement, much of it from the US.<sup>15</sup> Notwithstanding the different country contexts, our findings echo US ecological area-level analyses of the association between changing welfare benefits levels and substantiated maltreatment incidents.<sup>29</sup> They are consistent with quasi-experimental evidence showing the impact of exogenous shocks to household income on a range of child protection outcomes<sup>15,16</sup>. Intentional or incidental, policies that move children into poverty may trigger cascading inequalities through child protection systems and beyond, as poverty clusters with the very childhood adversities it produces,<sup>30</sup> giving rise to further inequalities in health, life and death.<sup>2</sup> This in turn has profound consequences for places and communities. Places that experience the double-burden of increased child poverty and numbers of children entering care must shoulder the wider societal costs of children's impaired life-chances, in education, health, criminal justice, and economic contexts.<sup>15</sup> In the short-term, the huge costs to the local authority of caring for these children<sup>5</sup> carry opportunity costs within and beyond Children's Services. Waning local investment in place-based public services that promote health and wellbeing may further deepen geographical inequalities, impeding the UK Government's bid to 'level-up' places that have historically been 'left behind', as part of the pandemic recovery effort.

The mechanisms by which income affects social care outcomes are increasingly clear. Explanatory models such as the family stress, investment and social models, describe how poverty may affect children directly, through material hardship, and indirectly, through the effect on family functioning.<sup>15</sup> Although the supply of child protection services may play a part in producing and replicating inequalities, there is strong evidence that poverty acts at the level of underlying need.<sup>15</sup> A 2020 systematic review of the impact of household income on children's outcomes in OECD countries identifies concrete evidence for a number of theorised causal pathways: a positive causal effect of income on known risk factors for child protection interventions, including maternal mental health, parenting, and home environment.<sup>31</sup> These findings affirm the plausibility of causal models for the impact of

poverty on care entry.<sup>15</sup> Moreover, the authors of the review note the larger effect sizes in experimental and quasi-experimental compared to fixed effects approaches, suggesting that our own findings may well be conservative.

### **Strengths and limitations**

To our knowledge, this is the first study in England to assess the relationship between child poverty and statutory child welfare interventions using longitudinal within-between models using data for the whole of England. It was made possible by the recent publication of higher-quality local authority-level, official child poverty data, spanning five years to 2020. They improve on previous local area estimates of child poverty by pooling data from the DWP and HMRC to capture both in and out-of-work poverty

Our study has several limitations. First, the lack of individual-level data on the SECs of child welfare-involved families led us to use an ecological design, and we cannot tease apart phenomena at the levels of the individual, household and wider community. Our focus on aggregate effects nevertheless reflects the need for place-based approaches to reducing health inequalities. Second, the new child poverty data were only available for a five-year timespan. Our analytic approach makes use of the variation in exposure between areas to assess the contribution to changing intervention rates within areas, and the time period is therefore appropriate. However, the analysis should be repeated as more data become available. Our within-between models may be subject to residual confounding by omitted time-varying variables that affect both exposure and outcome; we were also unable to consider causal lags without substantial loss of power. However, we can conceive of no variables likely to affect both area-level child poverty and care entry that are not also likely to be important mediators of the relationship of interest. Finally, the data have shortcomings. In child poverty statistics, a young person aged 16 to 19 is considered a child if they are in full time, non-advanced education. Not all children are counted. Changes to eligibility criteria for child tax credits mean that the relevant denominator cannot be accurately specified. As a result, ONS mid-year population estimates are now used to derive a child poverty rate, dictating the pragmatic exclusion of children over the age of 15. Where possible, we have constrained the age range of our outcomes accordingly, excluding from our purview a group of adolescents who represent an increasing proportion of children entering care.<sup>21</sup> However, due to the secondary suppression in data from Freedom of Information requests, our more acute secondary

outcome, the CPP rate, pertains to all children under the age of 18. As a result, some older children represented in the outcome may not have experienced the exposure.

### **Policy context and implications**

Currently, despite the importance of child poverty as a risk factor for becoming looked after, there remain obstacles to its recognition. Research into the place of poverty in UK practice identifies both social workers' reluctance to stigmatise poverty by making the link with child maltreatment, and, counter-intuitively, the persistence of an underclass discourse that is itself stigmatising.<sup>32</sup> Describing poverty as the “wallpaper of practice: too big to tackle and too familiar to notice”, Morris et al. advocate the use of poverty-aware social work paradigms.<sup>32</sup>

Our findings complement this assessment. For the two more acute outcomes, care entry and child protection plan initiation, the association with child poverty was evident regardless of the measure of child poverty used, indicating that support needs tied to changing SECs are reliably met with the most intrusive interventions. However, for the less acute child-in-need status, robustness tests were less conclusive. Changing SECs do not as reliably or consistently presage more upstream, family-oriented interventions. Children's needs are likely to increase with increasing child poverty. But the provision of 'child in need' services may not. This raises concerns voiced elsewhere about an underfunded, risk-averse child protection system, increasingly focussed on acute interventions at the expense of prevention.<sup>33</sup> It underscores the need for an approach to child protection that explicitly addresses the SECs of families' lives. There are emerging signs of a paradigm shift across the UK – efforts to 'strip the wallpaper of practice'.<sup>34</sup> Local area policymakers may redouble these efforts by embedding poverty-informed policies in Children's Services and multiagency partnerships. However, and particularly in the context of constrained resources and decision-making environments in local authorities, shifting population-level exposure to the risk factor of child poverty requires a national policy effort.

At national level, there has been a tendency to obscure the reality of trends in child poverty,<sup>35</sup> and a reluctance to acknowledge the relationship between poverty and care entry. The word 'poverty' does not appear in the Department for Education's 2016 strategy for children's social care or other key reports.<sup>36-38</sup> These reports acknowledge a correlation between deprivation and use of child protection interventions but go no further. Our study presents clear evidence that rising child poverty is likely fuelling care entry and other statutory interventions. National efforts to reverse adverse trends in care entry, interrupt spiralling

corporate parenting costs, and reduce inequalities, should prioritise poverty alleviation. Policymakers might begin by setting ambitious, achievable child poverty targets. Increasing the generosity of welfare support to families with children would likely have a rapid and lasting impact. In the UK, restoring the £20 universal credit uplift (appendix 1); extending the same uplift to those on legacy benefits; and reversing cuts to welfare benefits, including the two-child limit and lowered benefit cap, would lift millions of children out of poverty.<sup>11</sup> These policy proposals would dovetail with the UK Government's own 'levelling-up' post-pandemic recovery agenda, disproportionately benefitting the most deprived communities. Meanwhile, increasing funding to local authorities would support a shift away from reactive, acute intervention, towards preventive support. Although our analysis presents a grim picture, child poverty is a modifiable risk factor for care entry, highly amenable to policy intervention – where there is political will.

### **Declarations of interest**

We declare no conflicts of interest.

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### **Contributorship statement**

DB is lead author and guarantor. DT-R is senior author. DB, DT-R and BB conceived of the study. DB planned the analysis and acquired the data. DB conducted the analysis, with support from all authors. DS verified the underlying data. DB led the drafting and revision of the manuscript; all authors reviewed and revised drafts and approved the final version for submission. We confirm that authors have no conflicts of interest to disclose.

### **Data sharing**

All data used in this study are publicly available.



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## Supplementary materials

### Appendix 1. Cost estimates

#### *Corporate parenting costs associated with rising child poverty from 2015*

Based on our estimates of the annual marginal difference between observed trends in CLA rates, and trends that might have been expected had child poverty rates from 2015 remained stable, we estimated the corporate parenting costs associated with the difference. We used 2015-20 data on mean weekly expenditure per child in care, compiled by the Local Government Association,<sup>1</sup> and data for the same period on the mean duration of last period of care for children leaving care, from the Department for Education.<sup>2</sup> For each year, we multiplied our difference estimates by the mean annual cost, and mean duration of placement. We summed costs over the time period to obtain our overall estimate.

#### *Corporate parenting costs associated with the revocation of the £20-per-week Universal Credit uplift and minimum income floor*

Using Legatum Institute estimates of the number of children protected from moving into poverty by the £20 weekly Universal Credit uplift and minimum income floor,<sup>3</sup> and Department for Work and Pensions data on the number of children in poverty in the UK,<sup>4</sup> we derived the percentage rise in child poverty represented by a revocation of these protective measures. We then multiplied this percentage rise by our model estimates to contextualise the impact on children and families' involvement with children's social care.

Assuming that the relationship between child poverty and statutory child welfare interventions across the UK is comparable to that in England, and assuming comparable Social Metrics Commission and Households Below Average Income child poverty data, we estimate that the cut is likely to lead an additional 1,508 children entering care [95% CI 638–2,407]; 5,520 children becoming subject to a child protection plan [95% CI 3,567–7,482]; and 15,138 additional children beginning an episode of need, or receiving some form of care and support from the local authority [95% CI 3,944–26,332], each year.

Accordingly, using data on mean weekly expenditure per child in care<sup>1</sup> and mean duration of last period of care for children leaving care<sup>2</sup>, as above, we used 2020 figures to estimate the corporate parenting costs associated with the additional children likely to enter care as a result of the revocation. This amounts to an additional £225.6 million [£95.4 million – £360.0 million], each year.

## Appendix 2. Main model formula

Let:

- $Y_{it}$  denote the CLA/PPP/CIN rate, dependent on LA  $i$  and year  $t$
- $x_{1it}$  denote the child poverty rate, dependent on LA  $i$  and year  $t$
- $x_{2it}$  denote the employment rate, dependent on LA  $i$  and year  $t$
- $U_i$  denote LA random effects
- $\delta_t$  denote a series of dummy variables for each year  $t$
- $\varepsilon_{it} \sim N(0, S_1)$  denote the random error for LA  $i$  in year  $t$
- The overbar denote time-averages
- The superscript <sup>w</sup> or <sup>b</sup> denote decomposition into within- or between- LA effects of covariates

$$Y_{it} = \beta_0 + \beta_1^w(x_{1it} - \bar{x}_{1i}) + \beta_1^b(\bar{x}_{1i}) + \beta_2^w(x_{2it} - \bar{x}_{2i}) + \beta_2^b(\bar{x}_{2i}) + U_i + \delta_t + \varepsilon_{it}$$

## Appendix 3. Robustness tests

### *Alternative data sources and measures*

In robustness tests, as alternative measures of our exposure, we used: 1) absolute child poverty before housing costs, and 2) relative child poverty after housing costs. Absolute child poverty is measured against a static threshold that rises only with inflation, regardless of how the prosperity of a whole society may shift.<sup>5</sup> In official data this threshold is set to 2011, with absolute child poverty defined as the proportion of children living in households with less than 60% of the 2011 median income, adjusted for inflation.<sup>6</sup> Our measure of relative child poverty after housing costs is derived from before housing costs data by the Centre for Research in Social Policy. It takes into account the cost of rent, water, mortgage interest payments, buildings insurance payments, ground rent and service charges.<sup>7</sup>

### *Alternative modelling approaches*

We also used an alternative modelling approach, fitting Poisson within-between regression model to data on the number of children experiencing the different interventions, with the log of the relevant child population as an offset in the analysis, instead of modelling intervention rates directly. In the Poisson models, we accounted for overdispersion by including observation-level random effects.<sup>8</sup>

### *Discussion of robustness test results*

Summary and full model output for robustness tests are shown in appendices 7-10.

Robustness tests using alternative measures of our exposure show that, for our main outcome and more acute secondary outcome, findings are robust to the specification of poverty type (appendix 7 table 1). For children in need, however, the poverty measure accounting for housing costs revises the effect estimate downwards, with wide confidence intervals spanning the null.

The Poisson regression models validate our main finding of an association between changes in child poverty rates, and changes in intervention rates within local authorities, across the spectrum of statutory interventions (appendix 7 table 2). They additionally signal a greater relative increase in children being placed on a child protection plan compared to our main outcome and less acute secondary outcome, for a given increase in the child poverty rate, holding employment rates constant.

#### Appendix 4. Summary statistics

Appendix 4 table 1. Summary statistics for main outcome variable

Year	Main outcome variable			
	CLA rate (per 100,000 children < 16)			
	Mean	Sd.	Min	Max
2015	280.15	111.18	98.28	678.29
2016	277.46	110.73	73.85	823.03
2017	290.73	132.54	58.53	996.18
2018	273.49	118.85	75.91	778.21
2019	261.89	126.18	87.95	693.29
2020	260.00	141.34	101.93	931.88

Appendix 4 table 2. Summary statistics for secondary outcome variables

Year	Secondary outcome variables							
	CPP rate (per 100,000 children < 18)				CIN rate (per 100,000 children < 16)			
	Mean	Sd.	Min	Max	Mean	Sd.	Min	Max
2015	571.85	208.32	148.53	1577.29	3374.99	1395.97	1269.09	7884.70
2016	593.26	231.90	164.45	1803.37	3295.18	1189.50	1120.76	7816.81
2017	611.85	240.44	201.95	2145.85	3317.60	1231.04	1241.81	9489.46
2018	625.73	245.80	221.41	1557.72	3299.84	1108.04	1221.51	6735.77
2019	599.51	234.39	174.94	1712.57	3262.75	1072.43	1114.47	6876.37
2020	605.35	263.80	161.92	1564.27	3234.23	1235.58	1041.92	8145.64

## Appendices

Appendix 4 table 3. Summary statistics for exposure variable

Year	Main exposure variable			
	Relative child poverty, before housing costs (%)			
	Mean	Sd.	Min	Max
2015	15.62	5.16	5.35	29.73
2016	16.41	5.75	5.21	32.41
2017	17.33	6.28	5.35	34.63
2018	18.48	6.55	6.26	37.42
2019	18.73	6.74	6.17	38.34
2020	19.75	7.24	6.88	38.63

Appendix 4 table 4. Summary statistics for control variable

Year	Control variable			
	Employment rate (%)			
	Mean	Sd.	Min	Max
2015	72.26	5.03	60.00	82.90
2016	73.31	4.87	60.40	84.20
2017	73.74	4.99	60.90	82.30
2018	74.52	4.89	58.70	84.40
2019	74.85	4.61	61.70	84.30
2020	75.56	4.58	64.50	84.20

## Appendix 5. Summary main model results

Appendix 5 table 1. Within and between model output, taking child poverty as the exposure of interest

	Children starting to be looked after	Children made subject to a child protection plan	Children beginning an episode of need
Within-LA effects: Annual change in the rate per 100,000 for a 1% increase in child poverty, controlling for employment rates [95% CI] ( $\beta_1^w$ )	5.2 [2.2, 8.3]	19.0 [12.2, 25.8]	52.2 [13.6, 90.8]
Between-LA effects: Mean change in the rate per 100,000 for a 1% increase in average child poverty rates between LAs, controlling for employment rates [95% CI] ( $\beta_1^b$ )	8.9 [4.9, 12.8]	17.2 [9.7, 24.6]	38.8 [3.4, 74.3]



Appendices

**Appendix 6: Full main linear regression model output**

*Appendix 6 table 1. Full main linear regression model output.*

Parameter	CLA		CPP		CIN	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
<b>Fixed part</b>						
$\beta_0$ Intercept	338.58	230.60	426.51	439.04	8957.33	2088.45
$\beta_1^w$ Relative poverty	5.22	1.55	19.02	3.45	52.17	19.69
$\beta_1^b$ Relative poverty	8.85	2.00	17.16	3.80	38.84	18.09
$\beta_2^w$ Employment	0.50	1.16	0.88	2.59	-20.86	14.79
$\beta_2^b$ Employment	-2.75	2.72	-1.58	5.18	-83.71	24.63
$\delta_{2015}$ Year	-	-	-	-	-	-
$\delta_{2016}$ Year	-7.3764	6.66	5.36	14.85	-99.38	84.68
$\delta_{2017}$ Year	0.9197	7.17	6.22	15.97	-115.58	91.08
$\delta_{2018}$ Year	-22.7586	8.25	-2.60	18.38	-177.54	104.79
$\delta_{2019}$ Year	-35.8076	8.59	-33.79	19.14	-220.44	109.11
$\delta_{2020}$ Year	-43.4005	9.86	-48.05	21.97	-287.74	125.26
Parameter	Estimate	Std. Dev.	Estimate	Std. Dev.	Estimate	Std. Dev.
<b>Random part: LA level</b>						
Intercept variance	7946	89.14	28114	167.7	611019	781.7
<b>Random part: observation level</b>						
Residual variance	3043	55.17	15113	122.9	491319	700.9
Deviance	9990.8		11358.0		14375.4	
Log likelihood	-4995.4		-5679.0		-7187.7	
Number of local authorities	147		147		147	
Number of observations	882		882		882	
Note: the outcome is the absolute change in the intervention rate, per 100,000 children, for a 1% increase in relative child poverty before housing costs						

**Appendix 7. Summary robustness test results**

*Appendix 7 table 1. Linear regression model output, using alternative measures of our exposure*

	<b>Within-LA effects: Annual change in the rate per 100,000 for a 1% increase in child poverty, controlling for employment rates [95% CI]</b>		
<b>Poverty measure</b>	Children starting to be looked after	Children made subject to a child protection plan	Children beginning an episode of need
Relative poverty, before housing costs (main model)	5.2 [2.2, 8.3]	19.0 [12.3, 25.8]	52.2 [13.6, 90.8]
Absolute poverty, before housing costs	5.7 [1.9, 9.4]	22.3 [14.0, 30.7]	60.1 [12.6, 107.6]
Relative poverty, after housing costs	6.0 [3.4, 8.6]	16.1 [10.2, 21.9]	18.6 [-15.0, 52.3]

*Appendix 7 table 2. Poisson regression model output, using our main exposure, relative child poverty before housing costs*

	<b>Children starting to be looked after</b>	<b>Children made subject to a child protection plan</b>	<b>Children beginning an episode of need</b>
Within-LA effects: Percentage change in the rate for a 1% increase in child poverty, controlling for employment rates [95% CI]	1.2% [0.3%, 2.2%]	2.4% [1.3%, 3.5%]	1.6% [0.5%, 2.6%]
Between-LA effects: Percentage change in the rate for a 1% increase in average child poverty rates between LAs, controlling for employment rates [95% CI]	3.8% [2.5%, 5.1%]	3.4% [2.1%, 4.6%]	1.3% [0.3%, 2.4%]

Appendices

**Appendix 8: Full linear regression model output, using absolute poverty before housing costs as the exposure**

*Appendix 8 table 1. Full linear regression model output, using absolute poverty before housing costs as the exposure*

Parameter	CLA		CPP		CIN	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
<b>Fixed part</b>						
$\beta_0$ Intercept	352.38	229.00	384.95	434.28	8670.51	2065.15
$\beta_1^w$ Relative poverty	5.67	1.91	22.31	4.26	60.06	24.23
$\beta_1^b$ Relative poverty	9.83	2.26	19.60	4.29	46.38	20.39
$\beta_2^w$ Employment	0.59	1.17	1.21	2.60	-19.98	14.81
$\beta_2^b$ Employment	-3.04	2.70	-1.63	5.13	-81.94	24.37
$\delta_{2015}$ Year	-	-	-	-	-	-
$\delta_{2016}$ Year	-1.07	6.60	28.97	14.71	35.05	83.78
$\delta_{2017}$ Year	13.72	6.80	53.99	15.16	14.69	86.31
$\delta_{2018}$ Year	-5.59	7.00	60.59	15.60	-4.63	88.88
$\delta_{2019}$ Year	-18.88	7.12	28.10	15.87	-50.79	90.42
$\delta_{2020}$ Year	-24.02	7.54	21.92	16.81	-95.32	95.73
<b>Random part: LA level</b>						
Intercept variance	7983	89.35	28008	167.4	608359	780.0
<b>Random part: observation level</b>						
Residual variance	3054	55.26	15169	123.2	491902	701.4
Deviance	9994.0		11360.3		14375.7	
Log likelihood	-4997.0		-5680.1		-7187.9	
Number of local authorities	147		147		147	
Number of observations	882		882		882	
Note: the outcome is the absolute change in the intervention rate, per 100,000 children, for a 1% increase in absolute child poverty before housing costs						

Appendices

**Appendix 9: Full linear regression model output, using relative poverty after housing costs as the exposure**

Appendix 9 table 1. Full linear regression model output, using relative poverty after housing costs as the exposure

Parameter	CLA		CPP		CIN	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
<b>Fixed part</b>						
$\beta_0$ Intercept	1250.17	205.61	2272.08	391.91	9935.57	1752.71
$\beta_1^w$ Relative poverty	5.97	1.34	16.06	3.00	18.64	17.15
$\beta_1^b$ Relative poverty	-0.51	1.57	-1.89	3.00	27.15	13.41
$\beta_2^w$ Employment	0.72	1.16	1.48	2.60	-20.14	14.87
$\beta_2^b$ Employment	-12.75	2.31	-21.81	4.41	-99.94	19.70
$\delta_{2015}$ Year	-	-	-	-	-	-
$\delta_{2016}$ Year	-7.13	6.57	9.98	14.74	-70.10	84.30
$\delta_{2017}$ Year	-0.96	7.05	9.66	15.82	-60.20	90.45
$\delta_{2018}$ Year	-20.86	7.50	16.77	16.84	-68.84	96.26
$\delta_{2019}$ Year	-33.64	7.74	-12.49	17.35	-102.13	99.26
$\delta_{2020}$ Year	-37.03	8.19	-10.36	8.37	-119.54	105.09
<b>Random part: LA level</b>						
Intercept variance	9074	95.26	32255	179.6	612705	782.8
<b>Random part: observation level</b>						
Residual variance	3008	54.85	15145	123.1	495216	703.7
Deviance	10000.7		11378.3		14381.7	
Log likelihood	-5000.3		-5689.1		-7190.9	
Number of local authorities	147		147		147	
Number of observations	882		882		882	
Note: the outcome is the absolute change in the intervention rate, per 100,000 children, for a 1% increase in relative child poverty after housing costs						

**Appendix 10: Full Poisson regression model output**

*Appendix 10 table 1. Full Poisson regression model output.*

Parameter	CLA		CPP		CIN	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
<b>Fixed part</b>						
$\beta_0$ Intercept	-6.46	0.74	-6.10	0.69	-1.90	0.62
$\beta_1^w$ Relative poverty	0.01	0.00	0.02	0.01	0.02	0.01
$\beta_1^b$ Relative poverty	0.04	0.01	0.03	0.01	0.01	0.01
$\beta_2^w$ Employment	0.00	0.00	0.00	0.00	-0.00	0.00
$\beta_2^b$ Employment	-0.00	0.01	0.01	0.01	-0.02	0.01
$\delta_{2015}$ Year	-	-	-	-	-	-
$\delta_{2016}$ Year	-0.02	0.02	0.00	0.02	-0.02	0.02
$\delta_{2017}$ Year	-0.00	0.02	0.01	0.03	-0.02	0.03
$\delta_{2018}$ Year	-0.07	0.03	0.00	0.03	-0.03	0.02
$\delta_{2019}$ Year	-0.13	0.03	-0.05	0.03	-0.05	0.03
$\delta_{2020}$ Year	-0.17	0.03	-0.08	0.04		
<b>Random part: LA level</b>						
Intercept variance	0.08	0.28	0.07	0.26	0.05	0.23
<b>Random part: observation level</b>						
Intercept variance	0.02	0.16	0.04	0.19	0.04	0.19
Deviance	8694.3		10419.3		13161.4	
Log likelihood	-4347.1		-5209.7		-6580.7	
Number of local authorities	147		147		147	
Number of observations	882		882		882	
Note: the outcome is the log of the relative change in the intervention rate per 100,000 children, for a 1% increase in relative child poverty before housing costs						

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