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Working paper

The health effects of universal early childhood interventions: evidence from Sure Start

The Health Effects of Universal Early Childhood Interventions: Evidence from Sure Start

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August 13, 2021

Abstract

This paper evaluates the short- and medium-term health impacts of offering families with children under 5 universal access to centres providing childcare, health services, parenting support and parental job assistance. Increased access to these centres during early childhood increases the probability of hospitalisation for infants in the local area. As children age this effect turns negative and grows larger through primary and secondary school. The impacts are concentrated among boys from the poorest areas. The reductions in hospitalisations are driven by reduced infections, injuries, and mental health. The impacts during post-childcare age suggest that operating mechanisms are stronger immune systems, safer parenting practices and home environments, and improved emotional and behavioural development among children.

JEL Codes: I10, I14, I18.

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1 Introduction

Children's early exposure to poor, unsafe, and non-stimulating environments can have long-lasting impacts on their health and many other dimensions of their development (Almond, Currie and Duque, 2018; Shonkoff, Boyce and McEwen, 2009). There is evidence to suggest that early childhood interventions aimed to foster supportive and nurturing environments have potential to mitigate the impact of children's early exposure to these adverse conditions and produce long-lasting benefits for health (Conti, Mason and Poupakis, 2019; D'Onise, McDermott and Lynch, 2010). In doing so, they can be a cost-effective way of preventing disease, with benefits for both individual welfare and the public purse (García, Heckman and Ziff, 2018).

Most of this evidence, however, comes from randomised controlled trials of small-scale 'model' interventions in the U.S. (Campbell et al., 2014). Those are characterised by controlled delivery of intensive services and a very disadvantaged client base. Moreover, several studies have found that the benefits of these interventions are frequently mediated through increased take-up of private health insurance (Conti, Heckman and Pinto, 2016; Muennig et al., 2009). These facts raise at least two important questions for policy-makers around the world interested in helping children to improve their health through early intervention. First, can this type of interventions retain its effectiveness when implemented at scale and on less disadvantaged populations? Second, can positive health impacts still be achieved in contexts with universal free healthcare provision? Answering these questions is important to inform debates about the trade-offs of expanding access to targeted early interventions to less disadvantaged populations, not only in contexts with generous safety nets but also in US, where free healthcare is increasingly debated and already provided to low-income families.

This paper addresses these questions by evaluating the health benefits of a universal early childhood intervention in England, a context with free universal healthcare. The program, initially named Sure Start Local Programmes and later renamed Sure Start Children's Centres, was introduced in 1999 and quickly rolled out to become a network of over 3,500 centres offering local

families of children under 5 early education and childcare, health services, parenting support, and parental employment support. Despite being one of most ambitious government initiatives ever introduced for the under-fives in England, little is known about the impact it had on children and their families. This paper starts filling this gap by providing the first evidence of the short- and medium-term impacts of increased access to Sure Start on hospitalisations from infancy to adolescence.

To identify the causal impacts of exposure to these centres on children's hospitalisations, we exploit the variation in programme exposure induced by the 11-year rollout of the programme across areas of England. We use administrative data on the universe of admissions to publicly funded hospitals in England. We estimate the impact of increased access to centres in the local area of residence on hospitalisations of children at each age, from infancy up to 15. We find that the program led to significant increases in hospitalisations of infants and significant reduction in hospitalisations of children and adolescents.

The multifaceted nature of the program means that some of Sure Start's impacts on health could come about through a variety of channels, both directly through access to health services and indirectly – as a result of the components of the intervention focused on improving parenting, the home environment, or children's behavioural and cognitive development. To better understand the mechanisms underlying these impacts, we estimate the effects of Sure Start on cause-specific hospitalisations. We interpret these results in light of additional survey data about patterns of service take-up by child's age and family income. During infancy, when children were directly exposed and most likely to access Sure Start facilities, we find that the increase in hospitalisations is driven entirely by an increase in infection-related hospitalisations. This suggests that the increased exposure to infections in group-based settings and/or access to nurses for vaccination in these centres was an important mechanism at play. As children age, we find that infection-related hospitalisations then fall during the first few years of school, consistent with stronger immune systems. From age one, we find statistically significant falls in hospitalisations for external causes (predominantly injuries and poisonings); among young children, these causes are most closely related to

parental information about child safety and child health, improved parenting practices and reduced child maltreatment. In mid-adolescence, reductions in external admissions (again mainly due to injuries) could reflect less aggressive or risky behaviour, while falls in hospitalisations at ages 12 to 14 are mainly driven by admissions for mental health conditions, which are more prevalent in this age group than in younger children.

To shed light on the question of who benefits from universal interventions, we explore whether the impacts of the programme are heterogeneous across areas with different levels of deprivation. We find that impacts of the programme are strongest among children living in the 30% poorest areas of the country. As areas become richer, impacts decrease to become entirely null among children living in the 30% richest areas of the country. There are several possible reasons for these patterns. First, the service offer was supposed to be more comprehensive and of better quality in the poorest areas than in the richest areas. Second, we find evidence of differential take-up among families from different socio-economic backgrounds, with fairly equal take-up of health services but much stronger take-up of parenting support services. Although we are not able to provide direct evidence of this, another likely reason explaining the results is that the marginal benefits of accessing these centres were strongest among disadvantaged children. This could be because Sure Start compensated for their lower health endowment or because disadvantaged children had access to worse counterfactual services.

The potential for health impacts in the medium run to arise from multifaceted early years interventions has been seen with Head Start, which was the initial inspiration for Sure Start. The evidence on Head Start has been mixed, especially with regard to how long its benefits persist. The Head Start Impact Study RCT finds short-term benefits for children's cognitive and socio-emotional development, health status, health service use, and health insurance coverage which all fade out by the end of third grade (DHHS, 2010, 2012). However, more recent research has shown that the fade out of impacts might be partly explained by failing to account for the substitution between different types of public services (Kline and Walters, 2016) or by substantial heterogeneity in the effectiveness of Head Start centres (Walters, 2015). As well, other studies have found

medium-term benefits for mortality due to conditions that could plausibly be affected by the programme (Ludwig and Miller, 2007); obesity (Carneiro and Ginja, 2014; Frisvold and Lumeng, 2011); and depression (Carneiro and Ginja, 2014). In the longer run, Head Start has benefits for adult earnings, education, health insurance coverage, and risky behaviors such as smoking (Bailey, Sun and Timpe, 2020; Thompson, 2018).

Our paper contributes to the international evidence base on the impacts of early years interventions. Although there is a rich evidence base for programs such as the Carolina Abecedarian (ABC) and Perry Preschool Program (PPP), as well as for Head Start, these programs are all targeted at highly disadvantaged populations in contexts where the existing social safety net is relatively weak. For example, evaluations of all three programs found increases in health insurance coverage - a channel which will not be available in countries with universal health insurance, which is common today in many high-income countries.

So far, there has been less evidence to understand how fully universal early intervention programs affect child outcomes. A recent strand of work has analysed long-term impacts of programmes dating back to the origins of the welfare state in Scandinavian countries. Bhalotra, Karlsson and Nilsson (2017) study the introduction of universal post-natal health care, information, and support in the 1930s in Sweden. They find that the programme led to a 23% reduction in infant mortality and a 6.5% increase in the probability of surviving to age 75. Bütikofer, Løken and Salvanes (2019) also evaluate the very long-run impacts of a 1930s programme of mother and child health centres and post-natal home visiting in Norway. They find that access to the child visits during the first year of life increased schooling and earnings by age 30, it reduced the incidence of obesity and cardiac events in men, and that the effects were stronger for centres that offered a wider variety of health services. These evaluations of universal early interventions in Scandinavian countries have focused on the impacts of universal public health interventions introduced in the first half of the 20th century; like with the literature on Head Start, ABC and PPP, the provision of public services in this context was quite different from what it is today (Bhalotra, Karlsson and Nilsson, 2017; Bütikofer, Løken and Salvanes, 2019; Hjort, Sølvsten and Wüst, 2017).

Available evidence from contemporaneous programmes in Europe suggests that universal early years interventions - particularly expanding access to preschool education and formal childcare - can still benefit child cognitive and socio-emotional development in modern contexts with universal and free healthcare (Black et al., 2014; Felfe and Lalive, 2018; Havnes and Mogstad, 2011).¹ The evidence on the health benefits of such programs is just starting to emerge, with the handful of papers available again focusing on the Scandinavian countries. Siflinger and van den Berg (2020), for example, study a reform that provided universal childcare in one region of Sweden. Using the inpatient register and the outpatient register datasets for visits by children aged 1 to 7, they find that decreasing the price for childcare at age 1 decreases the number of medical visits at ages 4-5 and 6-7. They interpret these findings as the result of an income effect, where families that pay less for childcare have more resources available for the consumption of other inputs into early child health, such as more nutritious foods.

Our paper contributes to the existing literature by providing the first evaluation of a fully universal early childhood intervention implemented at the national level in a contemporaneous context with universal health coverage. In common with much of the rest of the literature, we evaluate an early years program that incorporates health services but is not solely targeted at improving health outcomes. Our results provide evidence that a fully universal intervention that is much less intensive than 'model' programs like the Perry Preschool and the Abecedarian programs can deliver benefits even in an institutional context with healthcare free at the point of use and pre-existing universal home visiting services.

While the multi-faceted nature of these programmes is perhaps one reason behind their success, this aspect creates particular challenges for their evaluation and the interpretation of findings. In particular, the fact that these programs offer a bundle of services means that health could be affected through a variety of channels, sometimes creating impacts of different directions in the short and the long run. For example, by bringing children more into contact with others, large-scale early years programs may increase the risk of infection in the short run while improving the immune

¹By contrast, Baker, Gruber and Milligan (2008) find negative effects for children of universally subsidised childcare in Quebec, Canada.

system and so reducing more serious infections in the medium run. Another possibility is that the program could have short-term impacts on non-health outcomes of parents and children (for example, parenting or behaviour) which in turn drive health impacts at older ages. To fully account for the effects of early years programs and to understand the channels through which they come about, it is therefore imperative to trace out the trajectory of their impacts from infancy and for as long as possible. The evidence on the medium-term effects of early childhood programs is notoriously scarce, and our paper is one of the first to present evidence of the impact of an early childhood intervention for what [Almond, Currie and Duque \(2018\)](#) have referred to as the ‘missing middle years’.

2 A brief history of Sure Start and its roll-out

First introduced in 1999 as Sure Start Local Programmes (SSLPs), Sure Start was conceived as an area-based intervention whose services would be available to all families in the neighbourhood of the centre. The programme targeted highly disadvantaged areas, though there was no means-testing ([Melhuish et al., 2008](#)). Sure Start was given a budget of £450 million over the period 1999-2002 to set up 250 projects, anticipating to reach 150,000 children over seven to ten years ([Pugh and Duffy, 2010](#)). While Sure Start was intended to be a flexible initiative that would respond to local needs, central government had overall control of its funding, and therefore input into how it was allocated between local areas. These functions were carried out by the Sure Start Unit (SSU), a joint responsibility of the education and health departments.

To decide which areas would get funding to open a Sure Start centre, the SSU developed a set of guidelines for the roll-out. The initial 60 ‘trailblazer’ districts invited to submit an application were selected based on the 1998 Index of Local Deprivation, augmented with low birth weight and teen pregnancy indicators. The set of trailblazers was also chosen to offer a good spread of different types of areas around the country ([DfEE, 1999](#)). All 60 trailblazers submitted a proposal, and on 9 April 1999 the government announced the first 21 projects to go ahead, with a further 30 announced in July. By November of that year, 15 had opened their doors as Sure Start Local

Programmes, across almost all regions of the country ([DfEE, 1999](#)). The public reception of SSLPs was extremely positive. In 2000 the government announced that it would more than double the Programme target, from 250 SSLPs to 530 ([Eisenstadt, 2011](#)). In total, 525 Local Programmes had been approved by the end of 2003.

In 2003, the government announced that, rather than being phased out after 10 years, Sure Start would be universalised and supported indefinitely. Under the new strategy, the SSLPs and other existing small-scale area-based early years services would transition into Sure Start Children's Centres (SSCCs) ([Lewis, 2011](#)).² The following year, the 10-Year Strategy for Childcare pledged “a children's centre in every community” by 2010, transforming what had so far been a highly targeted initiative into a universal programme ([HM Treasury, 2004](#)). The budget for Sure Start eventually rose from about £500m a year to £1.8 billion (in 2018-19 prices) at its peak in 2009-10, or about a third of overall spending on programmes for the under-5s in England ([Britton, Farquharson and Sibeta, 2019](#)).

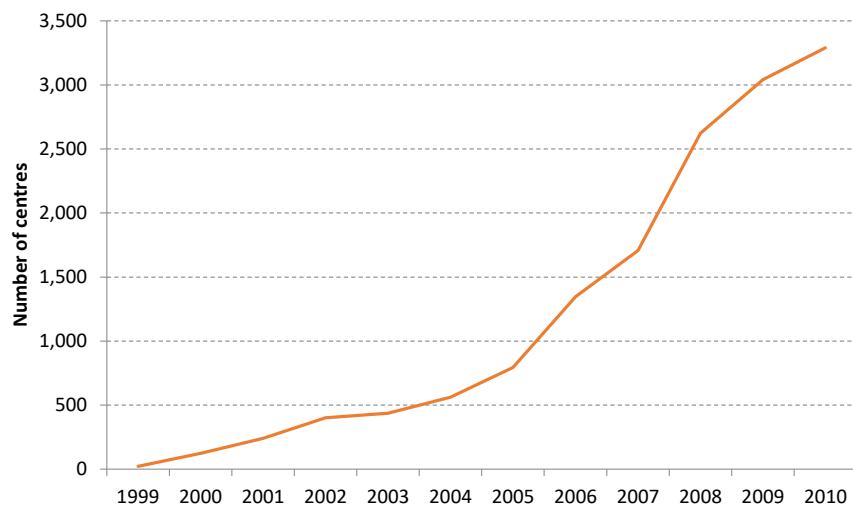
The Department for Education and Skills (DfES) had overall responsibility to establish 3,500 children's centres by 2010. However, it delegated responsibility to local authorities for planning and managing the children's centre programme in their area. This meant that, instead of the central government funding individual programmes through the SSU, LAs received funding, based on their number of children under five and the level of deprivation, and allocated it between Sure Start centres within their jurisdiction.

Local policy-makers were given less guidance for choosing the specific locations of their SSCCs, but the pledge to universalise the programme meant that the question was no longer which children would be served, but rather how quickly they would get access to it ([Lewis, 2011](#)). In addition, the very tight timeline for the programme expansion, heterogeneity in the availability of pre-existing services (e.g. SSLPs) on which to build, and greater local authority control meant that the roll-out of the SSCCs was more strongly driven by feasibility than by scores on a standardised set of indicators.

²These included a network of around 100 Early Excellence Centres. These were small-scale local centres with a focus on childcare provision that had largely evolved from local authority-owned childcare settings.

Nevertheless, the roll-out of the SSCCs was intended to be driven by deprivation. The expansion of the Children's Centres occurred in three phases, each with different targets ([House of Commons, 2010](#)). Between 2004 and 2006, there would be approximately 800 'Phase 1' centres to offer full coverage of the 20% most disadvantaged neighbourhoods. Of them, around 500 would grow out of existing SSLPs or other area-based initiatives while the rest would be new centres. In the second phase, between 2006 and 2008, 1700 new centres would open in the 30% most disadvantaged neighbourhoods. Finally, the third phase of the roll-out would complete the universalisation of the programme, through the opening of another 1000 centres in the remaining 70% of areas.

Figure 1: Number of Sure Start centres in England

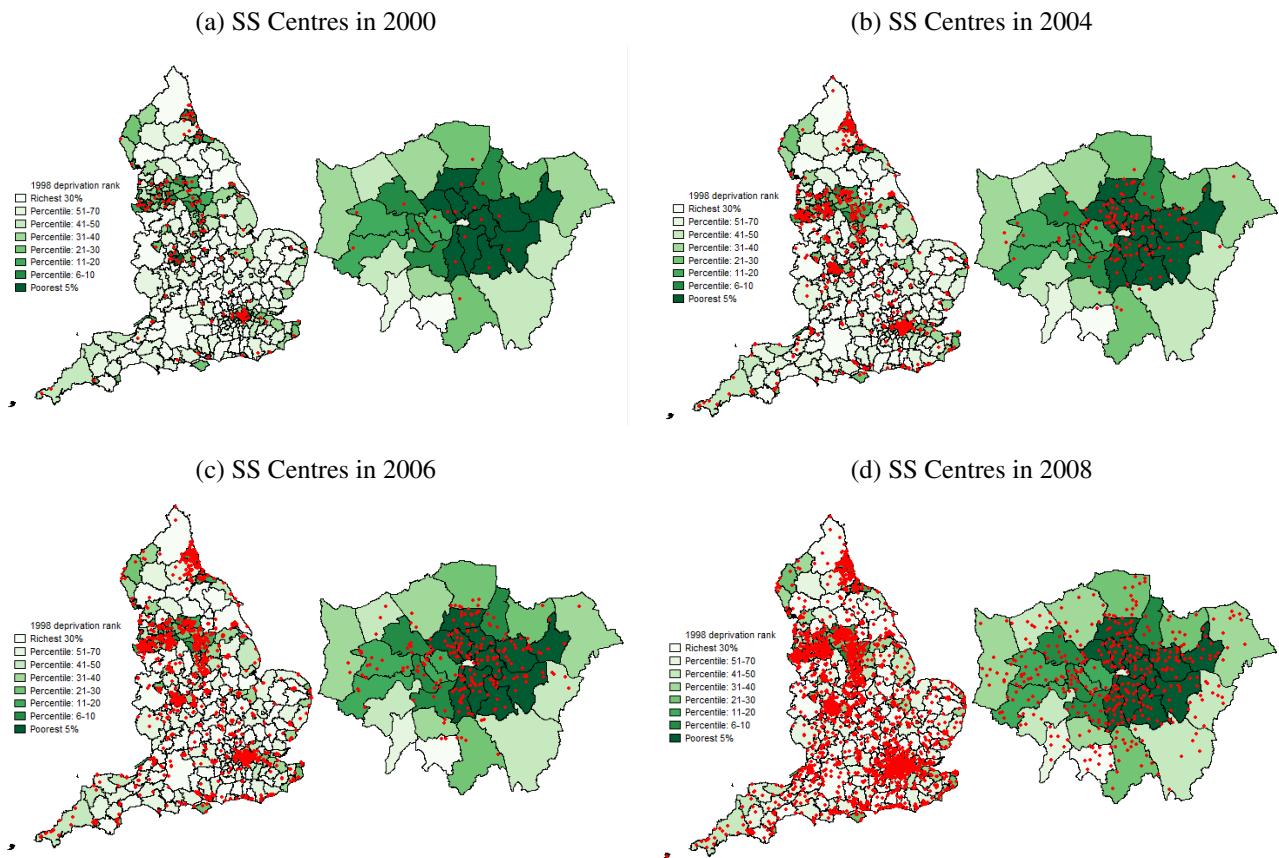


Note: The number of centres is based on centres observed in data received from the Department for Education. Since the treatment of arrangements like satellite sites was not always consistent, these numbers might not exactly match other data sources. We assume that a Sure Start Children's Centre (SSCC) opening at the same postcode as a Sure Start Local Programme (SSLP) replaces the SSLP; otherwise, we count both SSLPs and SSCCs between 2003 and 2006, and assume all SSLPs have closed from 2007 onward. Source: Authors' calculations using data provided by the Department for Education.

Following the roll-out plans, the period between 2005 and 2010 saw a rapid increase in the number of Sure Start centres ([House of Commons, 2010](#)). By 2010, the overall number of centres reached 3,500, with each centre serving a local population of between 600 and 1,200 children depending on the location and level of need (see [Figure 1](#)). The maps in [Figure 2](#), which show the

location of Sure Start centres in 2000, 2004, 2006, and 2008, suggest that the deprivation-based guidelines for each of the phases were taken seriously. During the first years of the programme roll-out, Local Programmes were predominantly opened in the most disadvantaged local authorities (shaded in darker green in the figure). By the time all of the Local Programmes had been opened, in 2004, the focus on relatively poor areas was even more obvious. Moreover, the maps also show a ‘filling-in’ pattern with facilities spreading across the country and intensifying over time, rather than starting in one region and spreading out from there. This is consistent with policymakers’ aim to ensure a good spread of Sure Start around the country.

Figure 2: Sure Start centres around England



Note: Local authorities are coloured by their rank in the 1998 Index of Local Deprivation, with more disadvantaged areas shaded more darkly. Each red point indicates the location of a Sure Start centre (SSLP or SSCC). The maps to the right of the maps of England are zoomed-in maps of London.

Besides the guidelines stated above, policy-makers could have informally used other indicators

for deciding when and where centres should open. In [Table A.1](#), we study the correlates of the expansion of the programme coverage by regressing two measures of the programme's expansion on a number of LA-level characteristics measured in 1998. The first measure (in Columns 1 and 2) is the log of the difference in the number of centres (per thousand children aged 0-4) in 2010 and 2000 in each LA. The second one (in Columns 3 and 4) is the first year a Sure Start centre (Local Programme or Children's Centre) opened in the LA. For each indicator of roll-out, we first consider the characteristics indicated indicated by the official guidelines (deprivation, low birth weight and teen conception rate) and then augment this set of variables with a range of other potential predictors, including local labour market condition, vital statistics, existing provision of childcare and health services, and indicators of potential demand for Sure Start services.³

This analysis shows that, in accordance with the guidance, Sure Start facilities opened in greater number (Column 1) and earlier (Column 3) in more deprived areas and areas with a higher teenage conception rate and a higher proportion of low birth weight births. However, once we include additional area characteristics (Column 2), we see that the growth rate in Sure Start facilities was higher in LAs with higher unemployment and potential demand for its services (as measured by the number of children aged 0-4 and the local funding for free part-time childcare). Column 4 indicates that LAs with higher unemployment rate and potential demand were also more likely to see a centre open earlier. The roll-out of Sure Start was therefore correlated with a number of area characteristics. This is an important feature of the policy we exploit and that needs consideration in our research strategy. As we elaborate on in [section 4](#), we will control for the potential confounding effects of these area characteristics through the inclusion of small-area fixed effects in our model.

Sure Start since 2010 Despite the 2003 government pledge that the program would be supported indefinitely, the policy landscape changed considerably after 2010 with the arrival of the Conservative government to power. Between 2011 and 2019, spending on Sure Start fell by over 60%

³Specifically, our regressor set includes the following variables: Job Seeker Allowance (JSA) claiming rate, which is a proxy for unemployment rate, infant mortality rate, proportion of 3-year-olds with access to a funded childcare place, number of General Practitioners (GPs) per 1,000 inhabitants, proportion of proportion under the age of 5, and proportion of children under the age of 5 who are Looked After (e.g. in care). All variables are measured in 1998, before the start of the Sure Start roll-out, and at the Local Authority (LA) level.

([Britton, Farquharson and Sibeta, 2019](#)). Following the removal of the funding ring-fence in April 2011, local authorities could choose to respond to these cuts in different ways. Some authorities subsidised Sure Start services from other budget lines, while other areas consolidated several centres into one, cut back on the hours or types of services offered, and/or entirely shut down centres ([Smith, 2018](#)). The core mission of the program was also made less prescriptive, allowing each centres to focus on the outcomes they wanted to achieve for young children and their families ([Smith, 2018](#)). In light of these important changes after 2010, we focus the empirical analysis presented in this paper on the 1999-2010 period during which the programme expanded and served local communities in a more consistent way throughout the country.⁴

3 Sure Start services

From its inception, Sure Start was created as a key mechanism for improving outcomes for young children. Its approach to child development was based on the recognition that the needs of families, particularly disadvantaged families, often span many traditional areas of support, and that child development is multi-dimensional. In line with this holistic approach to child development, the program offered a bundle of services that could have affected children's health (among other dimensions) through a variety of channels. In this section, we describe the services the programme offered before discussing the different ways in which we would expect the programme to have affected children's hospitalisations, our main outcome of interest.

⁴As we elaborate in Section 4, our empirical strategy exploits the variation in access to Sure Start resulting from the roll-out to identify the effect of increased access to Sure Start on children's hospitalisations. In principle, the reduction in Sure Start access resulting from centre closures could be used as well within such an empirical strategy. However, we refrain from doing so because, given the freedom with which LAs could respond to funding cuts, centre closures are more likely to be endogenous than their openings. Moreover, we only have imperfect information about centre closures. We have this data only for Children's Centres, and it indicates only when centres were formally closed. In practice, many local authorities chose to 'hollow out' services - in some cases to as little as half a day per week - rather than to close centres; few other LAs, instead, chose to close some of their centres but to deliver a full set of services through others.

3.1 What services did Sure Start offer and who took them up?

As the name suggests, Sure Start Local Programmes were designed and encouraged to be responsive to local needs, and partnerships and programme managers had wide latitude in the services they offered. [Meadows \(2011\)](#) report the expenditure shares of the different activities in 2003-2005. Just under a third of SSLPs expenditure was incurred on play, learning and childcare activities; a fifth of expenditure went on support for parents, and the same share on community healthcare – this was for provision not available through local mainstream NHS health services (e.g. postnatal depression services). A sixth of spending went on outreach and home visiting; support for children with special needs then accounted for 7% of the spending.⁵

Children's Centres had less autonomy than Local Programmes in choosing the services they would deliver, but they were still supposed to deliver a wide variety services. Centres in the 30% most deprived areas (Phase 1 and Phase 2 SSCCs) were required to provide the 'Core Offer', which consisted of early education and childcare; parental outreach; family and parenting support; child and family health services (antenatal support and links with *Job Centre Plus* ([Lewis, 2011](#))). For centres serving the 70% least disadvantaged areas ('Phase 3' SSCCs), services were less intensive, but all centres had to offer activities for children and links to *Job Centre Plus* and were expected to develop health and outreach services.

Relative to SSLPs, SSCCs had an increased focus on improving parental employment outcomes, both through the links with the new *Job Centre Plus* initiative and through the provision of childcare places ([Lewis, 2011](#)).⁶ Although there exists no data on the exact number of new childcare places created through the expansion of Sure Start, we would expect it to be small, relative to the large expansion of private nurseries during this period ([Blanden et al., 2016](#)). Neverthe-

⁵The remainder of expenditures was spent on premises costs and other activities ([Meadows, 2011](#)).

⁶In 1998, the government also announced its intention to entitle all three- and four-year-olds to part-time free early education and childcare. Universal provision for four-year-olds was established by 2000, but provision for three-year-olds was more gradual. In 2000 the Department for Education provided funds for childcare places for three year olds in 65 LEAs, and from 2001 places were rolled out across the country to achieve universal coverage by 2008 ([Blanden et al., 2016](#)). Funded places could be taken up in state nurseries, Sure Start centres, and private nurseries. As shown in [Blanden et al. \(2016\)](#), the take-up of childcare places was already high in the early 2000s, and the policy only led to the creation of 2.6 places for every ten places funded.

less, the quality of the childcare offered by Sure Start in disadvantaged areas may have been of greater quality than that of the childcare offered in private nurseries because Sure Start had higher requirements in terms of staff qualifications.⁷

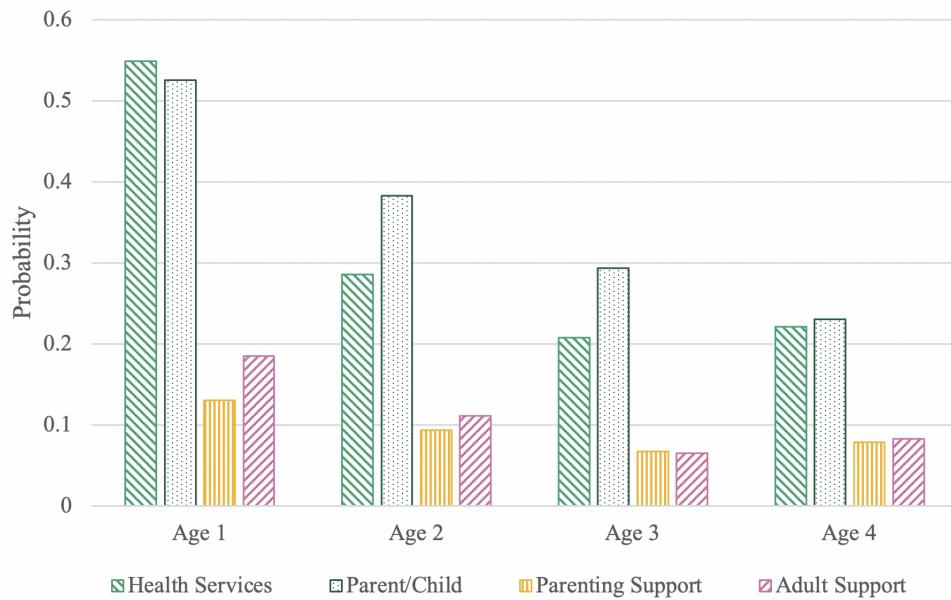
To date, the only systematic information on SSCCs' service offer comes from a 2011 survey of managers in Phase 1 and Phase 2 children's centres, collected as part of the Evaluation of Children's Centres in England (ECCE). Even if those data were collected after the main period we analyse, they are helpful to get some sense of what the service offer and patterns of usage by families were likely to be during the period of interest. Based on those data, [Goff and Chu \(2013\)](#) report that over 90% of the centres offered stay and play, evidence-based parenting programmes, early learning and childcare, developing/supporting volunteers, breastfeeding support. Other frequently offered services included midwife and health visitor clinics; sports and exercise for babies and children; advice on accessing welfare benefits, housing, and managing debt; adult learning; parent forums; and antenatal and postnatal classes.

The ECCE project also collected data on families who were registered to a Phase 1 or Phase 2 centres. While these data cannot be used to extrapolate what the take-up of Sure Start services was at the national level, they are the best indication available of the relative take-up of services across different groups of families.⁸ [Figure 3](#) shows that, across all ages, the services most likely to be used were health services and parent-child services (e.g. stay and play sessions, baby classes), though their take-up rapidly declined with the child's age. In contrast, the proportions of families using parenting support and adult support was lower, but more stable across children's age.

⁷Phase 1 Children's Centres required that a qualified teacher had to be appointed and each local authority was given a target number of childcare places to create. Phase 2 Centres also had to provide access to childcare, with a 0.5 full-time-equivalent qualified teacher post, though there was no target for new childcare places. Phase 3 Centres were not required to provide early learning and childcare places but could do so if the need arose ([House of Commons, 2010](#)). In contrast, private nurseries only required that 50% of staff must hold level 2 qualification, which is equivalent to two years post-compulsory schooling.

⁸The ECCE dataset was collected on parents who had an infant registered with one of the 128 children's centres selected to participate in the study. Data was collected at three points in time. In the baseline survey, 5,717 parents were surveyed through face-to-face interviews when their child was aged 9-18 months old. All parents who had agreed to be re-contacted and provided a telephone number were invited to take part in a second survey, and 3,588 phone interviews were contacted in 2013 when the selected child was aged about 2 years old. Another round of data was collected through face-to-face interviews of 2,692 parents whose selected child was now about 3 years old. The analysis reported in the paper pools all years of data together so as to reflect almost the entire range of eligible ages.

Figure 3: Take-up of services in Phase 1 and Phase 2 centres



Notes: The figure shows the probability that families in the ECCE sample report making use of each of the four main types of services, by the age of the focus child. This is based on pooling all three waves of ECCE data. Health services include e.g. ante-natal classes, breastfeeding groups, midwife/health visitor drop-in session or clinic; Parent/child services include e.g. stay and play, or play and learn drop-in sessions, organised sport or exercise for babies or children, toy libraries; Parenting support include peer support groups (parents supporting other parents), parenting classes, and specialist family or parenting support ; and Adult support includes e.g. benefits and tax credits advice, housing or debt advice, employment support, Basic IT or jobs skills course.

3.2 Expected effects of Sure Start on children's hospitalisations

Given the variety of services offered by Sure Start, the program could have affected children's health through a variety of channels. As mentioned in the introduction, we are not able to estimate the effect of Sure Start on measures of health, and instead rather focus on children's hospitalisations.⁹ This is an important distinction, as an increase in hospitalisations may not necessarily reflect a worsening of children's health especially in the short-term (e.g. if Sure Start played a role in referring families to appropriate childcare). In this section therefore, we set out our hypotheses about how each of the main groups of services could have affected health and hospitalisations in

⁹There are two nationally representative surveys that include measures of children's health in England, but each of them have issues that prevent this analysis. The British Household Panel Survey (BHPS) and its follower the UK Household Longitudinal Study have sample sizes that are too small. The Health Survey for England has larger sample sizes, but do not provide researchers access to precise enough geographical identifiers to carry out this analysis.

the short- and medium-term and discuss the mechanisms through which this could have been the case. We consider dynamics across three main periods: early years (when children were eligible to attend Sure Start, ie, under age 5), middle childhood (when the child is in primary school), and adolescence (between ages 11 and 15, which is the oldest age we can consider in our analysis).

Health services As mentioned above, both the SSLPs and the SSCCs offered a range of health services, including ante-natal and post-natal support for mothers and babies; advice on accident and injury prevention; advice on obesity, diet and nutrition; and support for mental health and for families with disabilities (e.g. [DfE, 2010](#); [DfES, 2003](#)). Sure Start therefore did not substitute for primary care provision (which is freely delivered in England by NHS General Practitioners), but rather enhanced access to health support and information. In doing so, we would expect the programme to improve children's health through two key mechanisms: a) by screening children for conditions and referring families to appropriate health care; and b) by enhancing health-promoting parental behaviours and the safety of the home environment. We hypothesise the first mechanism to lead to an increase in hospitalisations for manageable and preventable conditions in the short-term (early years) and a decrease in hospitalisations for the same conditions in the longer-term. We hypothesise the second mechanism to lead to a reduction in hospitalisations. Given Sure start provided information about accident prevention and safety in the home, we could expect this reduction to be particularly salient for accidents and poisoning, especially during the early years the period for which the information was tailored.¹⁰

Parenting support and parent/child services These services did not target health specifically, but may have improved children's health through the improvement of other dimensions of child development. Centres provided parenting classes to improve family functioning and positive parenting skills, often with a particular focus on children's mental health and emotional and behavioural

¹⁰Information was also provided about diet and nutrition, and we could also expect this advice to decrease the incidence of obesity. In a preliminary version of this paper ([Cattan et al., 2019](#)), we test for this mechanism directly by employing a similar research design and administrative data on weight and height of all children in primary school at ages 5. We find no evidence of effects of the programme on obesity. We rule out this mechanism going forward.

issues (such as the Triple P and Incredible Years programmes) (Goff and Chu, 2013). Parent/child activities may have also led to more nurturing parenting practices and greater child-parent attachment, which are crucial for healthy emotional and behavioural development (Case and Paxson, 2002). A calmer and less fidgety child may be less prone to injure herself and may be easier for parents to care for, thus potentially reducing the chance of parental neglect and maltreatment. As a result, if these services were effective, we hypothesise to find that Sure Start reduced hospitalisations for accidents and injuries during the early years. These reductions could be long-lasting if the programme made long-lasting impacts on parenting and the home environment. Moreover, if Sure Start improved children's emotional development, we could also expect a reduction in hospitalisations for mental health-related causes. However, given the fairly extreme nature of mental-health problems recorded in HES and the very low incidence of such hospitalisations before adolescence, we would not expect to pick up an effect on mental-health hospitalisations before adolescence.

Childcare If Sure Start increased the take-up of high-quality childcare among children, it could have affected health in two ways. First, the provision of high-quality childcare could have led to improvements in emotional and behavioural development among children. As such, we could expect similar effects of the programme on hospitalisations for accidents and injuries as those resulting from parenting support and parent/child services. Second, childcare (and to a lesser extent, parent/child activities) increased the time children spent around other children and hence their potential exposure to infectious diseases. In the short run, this might have led to an increase in the number of sickness episodes. But early exposure to a variety of pathogens also helps to build up the immune system, which might have benefits in the longer run (Henderson et al., 1979; Siflinger and van den Berg, 2020). If this were the case, we hypothesise hospitalisations for infections to increase in the short-term and drop in the medium-term. We would not expect these negative effects to be particularly long-lasting however, given that all children go to school from the age of 5 in England, and the immunity of those who were not in collective care earlier would likely catch up once they start school.

Adult support The last set of services offered by Sure Start aimed to support parents, especially in their effort to gain employment (e.g. links with *Job Centre Plus* to gain job-search assistant and job-related training). If Sure Start increased parental employment, it could affect children's health through different mechanisms. On the one hand, the associated increase in family income would allow parents to buy more and/or higher quality inputs, such as more nutritious food (Carneiro and Ginja, 2016). On the other hand, parents may have less time to spend with their children on health-improving activities with their children (e.g. cooking a home-made meal, accompanying them to the doctor). As a result of this change in parental time allocation, children may spend more time in childcare. The effect of this increase in the child's time spent in formal childcare would depend on the quality the chosen childcare relative to the quality of parental time (Bernal and Keane, 2011). Hence, the overall effect of Sure Start on children's health and hospitalisations through that channels would be ambiguous.

Table 1: Expected effects of Sure Start on children's hospitalisations

Mechanism	Services	Potential effect on hospitalisations		
		Early Years (c. age 1-4)	Middle childhood (c. age 5-10)	Adolescence (c. age 11-15)
Screening and referrals to appropriate healthcare	Health services	Ambiguous effect on hospitalisations for preventable diseases	Reduction in hospitalisations for preventable diseases	
Safer home environment	Health services	Reduction in hospitalisations for external causes (poisoning and accidents/injuries)		
Improved emotional and behavioural development (through improved parental and formal care)	Parenting support, parent/child activities, childcare	Reduction in hospitalisations for external causes, especially accidents and injuries		
		Reduction in hospitalisations for mental health-related reasons		
Stronger immune systems	Childcare, parent/child activities	Increase in hospitalisations for infections	Reduction in hospitalisations for infections	
Increased family income and parental employment	Adult support	Reduction in hospitalisations as a result of higher family income		
		Increase in hospitalisations from less parental time at home		

Summary [Table 1](#) summarises the discussion above. The first and second columns list the main mechanisms through which Sure Start could have affected children’s hospitalisations and the services that could have given rise to these mechanisms, respectively. The last three columns describe our hypotheses in terms of the effect we could expect each mechanism to have on hospitalisations at different ages. We have highlighted effects on the same type of hospitalisations in the same colour.

As the Table makes clear, Sure Start could have had effects of different signs for the same type of hospitalisation across ages, and for different types of hospitalisations at the same age. The latter implies that especially in the early years and middle childhood, the effect of the programme on hospitalisation for *any cause* is of ambiguous sign and could even be zero, since Sure Start could have had effects of opposite signs on hospitalisations for different causes. As children grow older however, we would expect the effect of Sure Start on overall admissions to be more clearly negative.

Because we do not have data on service take-up to link to hospitalisation data, we are not able to probe the mechanisms through which Sure Start worked directly. Instead, guided by the discussion above, after presenting estimates of impacts on overall admissions, we present estimates of impacts on cause-specific hospitalisations at different ages to help suggest what mechanisms were most likely at play ([subsection 6.2](#)). We also present a separate estimation of the effect of Sure Start on parental employment using another the Labour Force Survey (LFS) ([section D](#)). This analysis shows that this mechanism was unlikely to be an important one, which is why we shaded these rows in grey.

3.3 Previous evaluations of Sure Start

Before turning to the research design, it is important to note the relationship between this paper and two existing national evaluations of Sure Start commissioned by the government. Sure Start was first evaluated by the National Evaluation of Sure Start (NESS), which collected data on children living in neighbourhoods served by the first phase of Sure Start. These children were compared to

others surveyed in an earlier national survey who lived in areas not served by the programme. The NESS found an increase in parent-reported hospitalisations at 9 months, an increased prevalence of immunisations and a reduced probability of accidental injuries at age 3, and lower Body Mass Index (BMI) and better parent-reported health status by age 5 for children living in the Sure Start neighbourhoods (NESS, 2005, 2008, 2010). At age 5 and 7, it also found that this group had better family functioning (e.g. better home learning environment, less chaotic homes), greater social skills, and lower behavioural issues for 3-year-old children of non-teen mothers than the group not living in a neighbourhood with a Sure Start centre.

Following NESS, the next phase of Sure Start was evaluated by the Evaluation of Children's Centres in England (ECCE). This study collected detailed and extensive data on a sub-sample of centres and their users, and estimated impacts of Sure Start by comparing the outcomes of children who use the services with varying frequency. The authors found no significant association between using Sure Start services and child's health, but evidence that service use was associated with lower children's externalising behaviour, higher physical and maternal mental health and improved family functioning (ECCE, 2015).

Although the methodologies employed by these two evaluations are such that causal interpretations of findings warrant much caution, it is noteworthy that both NESS and ECCE found evidence of a link between Sure Start, child behaviour and parenting practices - a key mechanism our findings also suggest was at play. In contrast with previous evaluations, our paper proposes to evaluate the impact of greater access to Sure start by using a robust evaluation methodology exploiting the 11-year roll-out of the program and hospitalisation administrative data. Moreover, we examine impacts on hospitalisations much beyond the time horizon considered by these evaluations, from age 1 to age 15.

4 Data and Empirical Strategy

4.1 Data

The main data we use in this paper combines individual hospitalisation records in public hospitals in England with information about when and where each SSLP and SSCC opened.¹¹ To maximise comparability across cohorts, we restrict our sample to children born within 5 years of the announcement of Sure Start (i.e. those born in 1993 or later) and to children who could only have been exposed to Sure Start before the 2010 change in policy (i.e. those born in 2006 or before).

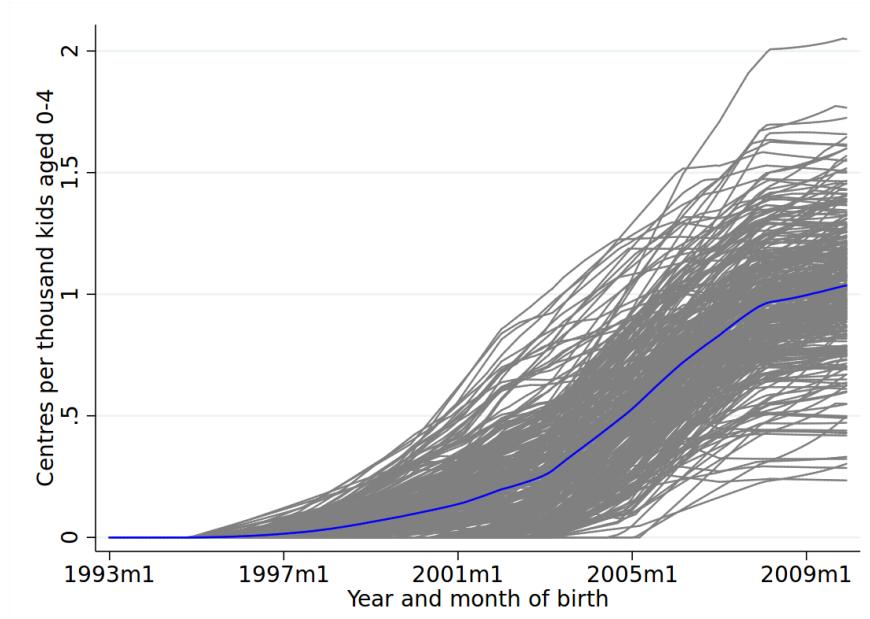
Data on Sure Start facilities To measure our treatment variable, we use a unique dataset containing the exact address and date of opening of each Sure Start Local Programme and Children's Centre between 1999 and 2010. Based on this information, we construct our measure of access to Sure Start SS_{dq} , such that it varies across Local Authority d and quarter of birth q (our cohort dimension). Specifically, we define SS_{dq} as the average number of centres per thousand children aged 0-4 that were open during the first 60 months of life of a child born in quarter q and living in Local Authority (LA) d .¹² When estimating models with an outcome measured before age 5, we define SS_{dq} as the average number of centres per thousand children aged 0-4 that were open between the child's birth and the age at which the outcome is measured. Figure 4 plots this variable for each of the 323 LA in England (in grey) and superimposes its average (in blue) across LAs. Across the cohorts we consider in the dataset, the number of SS centres per thousand children aged 0-4 increased from 0 to an average of 1.¹³

¹¹We also use a variety of auxiliary data as sources of information on local area characteristics and on policies contemporaneous to Sure Start to perform robustness checks. Those are described in Appendix Section ??.

¹²There are 326 Local Authorities (LAs) in England. We exclude three of them from the analysis (the Isles of Scilly, City of London, and West Somerset), which are very small areas with few children aged 0-4 and appear as outliers in terms of Sure Start coverage.

¹³Our treatment variable does not distinguish between Local Programmes and Children's Centres. While the opening dates of all centres are precisely known, pooling in this way requires us to make an assumption when SSLPs transitioned into SSCCs, which has not been recorded in the data. Since over 90% of SSLPs had transitioned into Children's Centres by 2006 (NAO, 2006), we assume that (a) any Local Programme that shares a postcode with a Children's Centre closed at the same time as the associated Children's Centre opened; and (b) all other Local Programmes closed in December 2006.

Figure 4: Average coverage over the first 60 months of life, by local authority and month and year of birth



Notes: Each grey line represents one of 323 local authority districts in England (excluding the Isles of Scilly, City of London, and West Somerset). The blue line shows the average for all of England. The lines plot the average Sure Start coverage (centres per thousand children aged 0-4 in the district) over the first five years of life for children based on their month and year of birth. Source: Authors' calculations using data from the Department for Education and ONS population estimates.

Data on hospitalisations We use the Hospital Episode Statistics (HES), an administrative dataset tracking the universe of patients using English public hospitals. Data on inpatient admissions has been collected since April 1997 and we have data up to March 2018. The inpatient data tracks all hospital admissions, providing information on the admission, discharge, clinical diagnoses (up to 20 for each patient), and demographics of each patient.¹⁴ The dataset also includes information on the patient's sex, ethnicity, date of birth, and the Lower-level Super Output Area (LSOA) of residence at the time of admission.¹⁵

¹⁴In this context, inpatient admissions include day cases who are admitted to a hospital bed as well as those who stay overnight. There is a separate register for emergency room attendance, but these data are only considered reliable from April 2007, so there is less scope to look at the impacts of Sure Start across the entire life-cycle of the programme. Similarly, the register for outpatient data is only reliable from April 2006.

¹⁵The LSOA is a very small geographic unit. There are around 33,000 LSOAs in England, and the average LSOA has a population of around 1,500 residents. LSOAs are a unit of statistical rather than practical geography, so there are no administrative or electoral responsibilities that are conducted at the LSOA level. However, LSOAs map to Local Authorities (LA), which do have a role in administering a wide range of policies.

To create our outcomes of interest, we include one record per hospitalisation (though patients may have several ‘episodes’ under different physicians during a single spell of hospitalisation) and exclude admissions related to the birth of a child. We then construct counts of all-cause and (primary) cause-specific admissions for each neighbourhood (defined at the LSOA level), quarter of birth, sex and age of admission. Cells without admissions are assigned zero. Because a large fraction of cells have zero admissions, we define our main outcome of interest as $D_{sql(d)}^{ya}$, an indicator for whether there is any hospitalisation of type y at age a for children of sex s born in quarter q and residing in neighbourhood l (of LA d).

4.2 Empirical Specification

Our aim is to estimate the effect of increased access to Sure Start on children’s hospitalisations (for any cause and for specific causes). To do so, we exploit the variation in potential exposure to Sure Start across birth cohorts and Local Authority generated by the Sure Start roll-out and displayed in [Figure 4](#) in a standard difference-in-difference framework. We operationalise it by way of a two-way fixed effect model, where we control for: i) birth cohort fixed effects to account for secular trends in hospitalisation, and ii) neighbourhood fixed effects to account for systematic differences in time-invariant area characteristics that may be correlated with both the Sure Start roll-out and hospitalisations.

Our main estimating equation has the following specification:

$$D_{sql(d)}^{ya} = \delta^{ya} SS_{dq} + \beta^{ya} X_s + \alpha^{ya} Pop_{al} + \gamma_q^{ya} + \pi_{l(d)}^{ya} + \nu_{sql(d)}^{ya}, a = 1, \dots, 15 \quad (1)$$

where $D_{sql(d)}$ and SS_{dq} are defined as above, X_s is a female dummy and Pop_{al} is the number of children of age a in neighbourhood l . γ_q is a set of cohort of birth fixed effects defined at the year-quarter level. The model includes a set of over 32,000 neighbourhood fixed effects π_l , which account for time-invariant unobserved heterogeneity across areas. Controlling for neighbourhood fixed effects is crucial in light of the evidence presenting in [Section 2](#) that the roll-out of Sure

Start was correlated with local potential demand and deprivation. Finally, the error term is denoted

$$v_{sdl(d)}^{ya}.$$

The parameter of interest is the coefficient δ^{ya} , which measures the effect of increasing access to Sure Start by one centre per thousand children on the probability that a neighbourhood-sex-birth quarter-birth year cell experiences at least one hospitalisation.¹⁶ An increase of one centre per thousand children is equivalent to the average increase in coverage across the whole roll-out period (although individual areas will have seen higher or lower increase). The parameter δ^{ya} is therefore an Intention-To-Treat (ITT) parameter. Given that Sure Start was designed as an area-based intervention, this parameter also corresponds to the relevant parameter to compute the net benefits of the policy.

In Section 5, we report the estimates of parameters in equation (1) for admissions for any cause and ages $a = 1, \dots, 15$. In Section 6, we report the results of the same model for specific causes outlined earlier in Section as part of our discussion of mechanisms. In Section 7, we examine whether treatment effects are heterogeneous by gender and by level of deprivation. Because the probability of hospitalisation can vary quite substantially across ages and cause of admission, we present most of our results with graphs showing the proportionate effect of an increase in Sure Start access, relative to a baseline probability measured in 1996, from ages 1 to 15. Estimates underlying the graphs are reported in the Appendix.

Inference For all models considered, we present robust standard errors clustered at the level of local authority at the time of admission to account for autocorrelation in the outcomes (Bertrand, Duflo and Mullainathan, 2004). Because we study the effects on a relatively large number of potentially correlated outcomes, we also report the results of a stepwise multiple hypothesis testing procedure that controls for familywise error rate. In particular, we use the procedure in algorithms 4.1 and 4.2 of Romano and Wolf (2005) to account for testing several hypotheses simultaneously;

¹⁶Our main measure of treatment in equation (1) is a "dose-response" model that captures simultaneously the 'extensive' margin of Sure Start (whether there is any centre open in the local authority) as well as the 'intensive' margin (how many centres are available). Hence, we also explore non-linearities of the effect to disentangle intensive from extensive margins in Section 5.

this is an iterative rejection/acceptance method for a fixed level of significance. We use 500 block-bootstrap replications to obtain the adjusted critical values (the block is the Local Authority). The result tables indicate whether the coefficients remain significant at a level of 1, 5, or 10 percent after using this procedure. In line with our discussion of expected effects, when applying this correction we consider the different phases of child development and test simultaneously the impacts for three age groups: 0 to 4 (early years), 5 to 10 (middle childhood) and 11-15 (adolescence).

4.3 Validity of empirical strategy

The interpretation of the parameter δ^a as the causal effect of increasing *access* to Sure Start relies on two crucial assumptions: (1) that greater access to Sure Start (living closer to more centres) increases the probability of participation, and (2) the “parallel trends” assumption that the roll-out of Sure Start across LA was uncorrelated with trends in hospitalisations and/or time-varying shocks that also affected hospitalisations. This section provides evidence supporting the validity of both assumptions.

Access to Sure Start and participation Sure Start was an area-based intervention, with most Local Programmes and Children’s Centres defining a ‘reach area’ where outreach would be targeted most intensively. Local authorities had a statutory duty to ensure sufficiency of provision for all families living in their area and centres were periodically evaluated by a national regulator on how effectively they were reaching their target population and the extent to which their services were taken up ([DfE, 2010](#)).

Unfortunately, for most of Sure Start’s history, there was no systematic collection of these take-up figures, which makes it impossible to directly test the assumption that greater access implied greater usage. However, some illustrative figures from the 2012 ECCE project confirm that families who took up Sure Start services typically lived close to a children’s centre: 78% lived within 1.5 kilometres of the centre, and 30 per cent within 500 metres ([Goff and Chu, 2013](#)). Families were also encouraged to use services from a range of centres, visiting different centres on different days

to attend the programming that was most relevant to them. Within local authorities, Sure Start centres were often encouraged to operate as part of a network: in 2011, for example, 40% of centres were explicitly organised as part of a wider network (Sylva and Sammons, 2015). In order to reflect the importance of these local networks of services, we focus on an LA-based measure of coverage.¹⁷

Parallel trends assumption The parallel trends assumption requires that the roll-out of Sure Start was uncorrelated with pre-existing trends in hospitalisations and that there were no confounding shocks or policy changes that were correlated with its subsequent rollout. This section presents a number of exercises that probe the validity of these two assumptions.

Parallel pre-trends We use formal statistical tests to examine whether hospitalisations followed parallel trends before the implementation of Sure Start in each local area. Following suggestions in Borusyak, Jaravel and Spiess (Working Paper), we test whether hospitalisations in LSOA l (located in LA d) and cohort of birth q are correlated with future Sure Start coverage in this LSOA (or ‘leads’ of the treatment variable) in the sample of cells where $SS_{dq} = 0$. This is analogous to testing for pre-trends in event study designs, as in Bailey, Sun and Timpe (2020), though using our continuous measure of Sure Start coverage. Specifically, we estimate for each age $a = 1, \dots, 15$:

$$D_{sql(d)}^{ya} = \sum_{q=15}^1 \delta_q^{ya} SS_{qd} + \beta^{ya} X_s + \alpha^{ya} Pop_{al} + \pi_{l(d)}^{ya} + \gamma_q^{ya} + \nu_{sql(d)}^{ya}$$

where we include the leads of our treatment variable over 16 quarters (4 years) following the time hospitalisations are measured. The estimates of the parameters δ_q^{ya} are reported in Table 2 with 4 yearly leads, where the last row reports the p-value of a F-test jointly testing those coefficients against the null that they are zero. The coefficients δ_q^{ya} are small and statistically insignificant, and for almost all ages we cannot reject that they are jointly 0. This suggests that the introduction of Sure Start was not related to pre-existing trends in hospitalisations.

¹⁷Using an LA-based measure of coverage rather than a distance-based treatment measure also reduces measurement error, since we do not observe precise postcode information in the HES data.

Table 2: Effect of an increase in the lead value of Sure Start coverage on the probability of hospitalisation for any cause: 4 yearly leads

	(1) Age 1	(2) Age 2	(3) Age 3	(4) Age 4	(5) Age 5	(6) Age 6	(7) Age 7	(8) Age 8	(9) Age 9	(10) Age 10	(11) Age 11	(12) Age 12	(13) Age 13	(14) Age 14	(15) Age 15	
1 year lead	1.409* (1.95)	0.69 (0.89)	-0.27 (-0.37)	-0.465 (-0.65)	0.424 (0.66)	-0.0897 (-0.15)	0.0768 (0.12)	0.685 (1.1)	0.207 (0.35)	-0.59 (-0.99)	0.204 (0.35)	0.0778 (0.12)	-0.451 (-0.69)	-0.517 (-0.76)	0.019 (0.02)	
2 year lead	-0.483 (-1.30)	-0.422 (-1.17)	0.0851 (0.25)	-0.0036 (-0.01)	-0.412 (-1.29)	-0.0238 (-0.08)	-0.42 (-1.30)	-0.46 (-1.53)	-0.0818 (-0.27)	0.267 (0.92)	-0.287 (0.95)	-0.14 (-0.47)	0.0976 (0.32)	0.399 (1.21)	-0.21 (-0.45)	
3 year lead	0.203 (0.98)	0.405* (1.9)	0.231 (1)	0.205 (1.02)	0.387* (1.8)	0.101 (0.48)	0.265 (1.41)	0.179 (0.99)	0.0435 (0.21)	-0.086 (-0.45)	0.352* (1.78)	0.221 (1.78)	0.078 (1.27)	-0.169 (0.37)	0.103 (-0.79)	0.103 (0.33)
4 year lead	-0.0967 (-1.15)	-0.217** (-2.37)	-0.272*** (-2.89)	-0.132 (-1.59)	-0.210** (-2.19)	-0.0507 (-0.59)	-0.0792 (-1.03)	-0.0339 (-0.44)	-0.0636 (-0.75)	0.00328 (0.04)	-0.151* (-1.86)	-0.126 (-1.57)	-0.0697 (-0.79)	-0.0324 (-0.35)	-0.0945 (-0.73)	
N	104982	140746	201752	267384	267384	267384	267384	267384	267384	267384	267384	267384	263368	254062	240086	
P-value	0.1641	0.2137	0.0000	0.3664	0.1604	0.9714	0.1291	0.6165	0.519	0.8729	0.3509	0.6144	0.7885	0.3074	0.529	

Notes: The table shows coefficients for regression analyses at each outcome age. Observations are cells defined by the LSOA, year of birth, and sex. The model regresses an indicator for any hospitalization in a cell on 4 yearly lags of the Sure Start coverage, the population at the relevant age in the LSOA and an indicator for female and includes fixed effects for year birth and the LSOA of residence. Sure Start coverage is defined as the number of centres per thousand children aged 0–4 in the local authority for outcomes at age 5 and older; when studying outcomes for younger ages, $a = 1, \dots, 4$. SS_{qd} is defined the number of centres per thousand children aged 0–4 that were open in the LA d when the child was aged $a - 1$. The baseline mean is measured in 1996. Standard errors are shown in parentheses clustered by LAD.

To provide further reassurance that differential trends across areas are not driving our results, we conduct robustness checks which augment the main specification in equation 1 to control for LA-specific trends. If these different trends were important in our setting, we would expect our results to change substantially when we include them in our model. We implement these robustness checks in a variety of ways: (a) we include LA-specific linear trends in the model and (b) we include a set of interactions between the cohort fixed effects and pre-Sure Start LA-level characteristics (measured in 1998, the year before the first SSLP opened).

Parallel trends post-implementation While local authorities were on parallel trends before the introduction of Sure Start, they may have been subject to other shocks during the programme’s roll-out that disrupted these trends. To the extent that these correlate with the roll-out of Sure Start, we will mistakenly attribute them to the programme. We therefore provide several pieces of suggestive evidence that indicate that our results are robust to a wide variety of potential confounders.

One crucial set of potential confounders is the local service offer. Over the decade that Sure Start was rolled out, the national government also made a number of reforms to the benefit system, the health system and the early years system. In-work benefits became more generous while out-of-work benefits were reduced (Gregg, 2008); health spending rose from 5% to 7.5% of GDP (Stoye and Zaranko, 2019); and the government introduced and expanded a new part-time childcare entitlement for 4-year-olds (later extended to 3-year-olds) (Blanden et al., 2016). While our empirical strategy allows for outcomes to change over time, many of these reforms likely impacted local authorities differently. We therefore present a robustness check that controls for a range of LA-level characteristics, including the roll-out of funded childcare places; the number of physicians (General Practitioners) per capita, a proxy for health service availability; and local labour market characteristics (to reflect changes in the benefit system incentivising employment). In addition to these measures of the policy environment, we also incorporate a wide range of other characteristics that may be related to both the roll-out of Sure Start and the incidence of hospitalisations. These include local demographics; vital statistics; and labour market characteristics (see Appendix B for

the full list of variables and sources). If any of these characteristics is confounding our results - or is correlated to another unobserved characteristic that is confounding our results - we would find that our results are not robust to these specifications. As we show in the results of these checks in Section 5.1, this is not the case, thus providing reassuring evidence that the effect of Sure Start access we estimate is not confounded by the effect of other policies.

5 Sure Start's effects on overall hospitalisations

Table 3 reports the estimates of the effect of a one-centre (per thousand children) increase in access to Sure Start on hospitalisations for any cause between the ages of 1 and 15. These effects are estimated separately from 15 regressions (one for each age of admission). Figure 5 plots these estimates re-scaled by the baseline probability of any hospitalisation at the corresponding age to enable comparison of relative effects across ages.¹⁸

These results show that, during the earliest years of life, an increase in Sure Start coverage resulted in an increase in hospital admissions. In particular, an additional centre per thousand children raises the probability of any hospitalisation at age 1 in a cell by 2.6 percentage points, a 10% rise relative to the pre-Sure Start baseline (when 26% of LSOA-sex-quarter of birth cells had at least one hospitalisation). This translates into approximately 6700 additional yearly hospitalisations.¹⁹ Figure 5 also shows clearly that these early increases in hospitalisations are followed by substantial decreases in the probability of admission through childhood and early adolescence. Once children turn 5 and stop being age-eligible to use Sure Start services, the overall impact on hospitalisations becomes consistently negative, with larger impacts during the first few years of schooling (age 5-6) and then from age 10 onward. Exposure to an additional centre per thousand children at ages 0-4 averts around 7% of hospital admissions at age 5, 8% by the end of primary school at age 11, and 8.5% by age 15 (the final age we study). This represents around 2,860 fewer

¹⁸We use the mean from the cohort born in 1996 as our baseline, also reported in Table 3.

¹⁹To compute the number of yearly averted or additional all-causes hospitalisations engendered by the presence of an additional centre per thousand children, we multiply the estimates of parameter δ^{ya} , as defined in model 1 and presented in Table 3, by the number of observations per year, which is 262,528. Our analysis is carried out at the LSOA-quarter and year of birth- gender level, with 32,816 LSOAs thus generating 262,528 yearly observations.

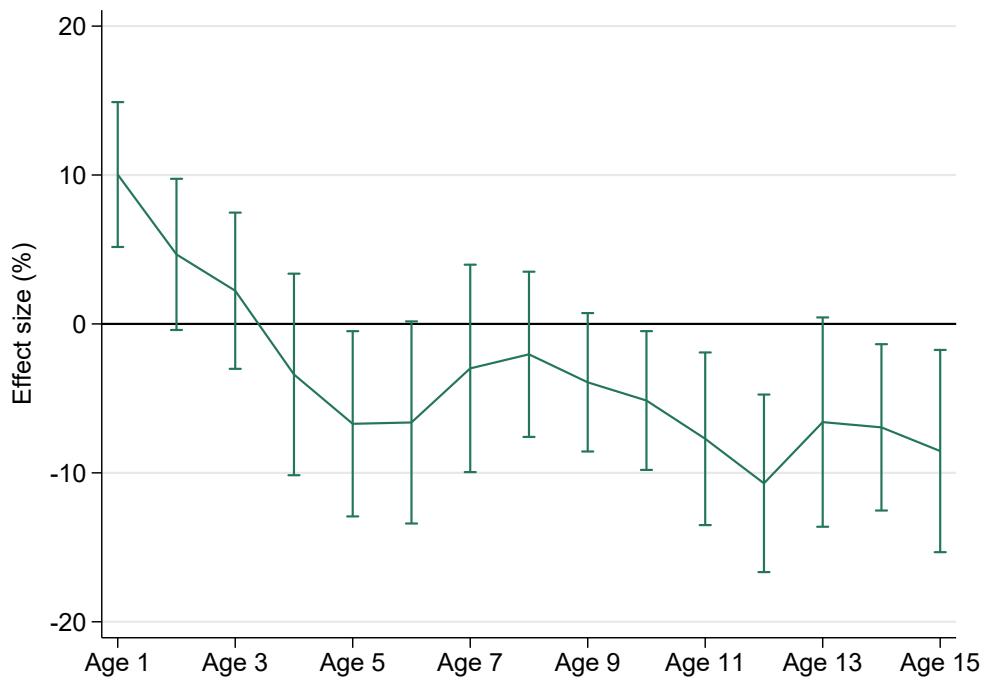
Table 3: Effect of an increase in Sure Start coverage on probability of hospitalisation for any cause

	(1) Age 1	(2) Age 2	(3) Age 3	(4) Age 4	(5) Age 5	(6) Age 6	(7) Age 7	(8) Age 8	(9) Age 9	(10) Age 10	(11) Age 11	(12) Age 12	(13) Age 13	(14) Age 14	(15) Age 15
SS Cov	0.0256*** (0.0075)+++	0.0095 (0.0063)	0.0040 (0.0057)	-0.0057 (0.0069)	-0.0109* (0.0061)	-0.0095 (0.0059)	-0.0038 (0.0053)	-0.0024 (0.0039)	-0.0044 (0.0032)	-0.0055* (0.0031)	-0.0084** (0.0038)+	-0.0125*** (0.0042)+++	-0.0081 (0.0052)	-0.0091** (0.0045)	-0.0120** (0.0058)
Baseline mean	0.2552	0.2044	0.1791	0.1687	0.1623	0.1438	0.1260	0.1160	0.1125	0.1078	0.1089	0.1172	0.1229	0.1311	0.1410
N	2822176	3084704	3347232	3609760	3675392	3675392	3675392	3675392	3675392	3675392	3478496	3215968	2953440	2690912	2428384
Earliest cohort	apr.96 des.06	apr.95 des.06	apr.94 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 mar.06	jan.93 mar.06	jan.93 mar.05	jan.93 mar.04	jan.93 mar.03
Latest cohort															

The table shows coefficients from regression analysis at each outcome age. Observations are cells defined by the LSOA, quarter-year of birth, and sex. The model regresses an indicator for any hospitalisation in a cell on Sure Start coverage, the population at the relevant age in the LSOA and an indicator for female and includes fixed effects for quarter-year of birth and the LSOA of residence. Sure Start coverage is defined as the number of centres per thousand children aged 0–4 in the local authority for outcomes at age 5 and older; when studying outcomes for younger ages, $a = 1, \dots, 4$. SS_{qa} is defined the number of centres per thousand children aged 0–4 that were open in the LA d when the child was aged $a - 1$. The baseline mean is measured in 1996. Standard errors are shown in parentheses clustered by LAD. 'Earliest' and 'latest' refer to the first and last birth cohort included in each regression. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively; +, ++ and +++ indicate significance at the 10%, 5% and 1% level, respectively, after adjusting inference following the procedure in algorithms 4.1 and 4.2 of [Romano and Wolf \(2005\)](#).

yearly hospitalisations at age 5 and over 13,150 prevented hospitalisations of 11-to 15-year-olds each year. **Table 3** also indicates whether the estimates are still significant after adjusting inference to multiple hypothesis testing: the increase in admissions among infants and the reductions at ages 11 and 12 survive this adjustment.

Figure 5: Effect of an increase in Sure Start coverage on probability of any hospitalisation in the neighbourhood, rescaled by baseline probability



Note: Effect sizes are constructed by rescaling the estimates by the pre-Sure Start baseline probability of a hospitalisation at each age. Vertical bars indicate 90% confidence intervals. Source: Authors' calculations using data from the Hospital Episode Statistics inpatient data (1997-2017) and the Department for Education's data on the roll-out of Sure Start.

5.1 Robustness checks and specification checks

5.1.1 Validity of the ‘parallel trends’ assumption

As discussed in Section 4.3, our difference-in-difference design relies on the assumption of parallel trends in hospitalisations between different local authority treatment units. We have already presented the results of a formal test for pre-trends in hospitalisations. In this section we turn to the results of a range of robustness checks that help to evaluate the plausibility of the assumption

of continuing parallel trends (in the absence of Sure Start).

Differential time trends We first augment the model to allow for differential trends in hospitalisations across Local Authorities. If the results of these specifications are similar to those obtained in the main model (equation 1), we can be more confident that trends in outcomes have similar slopes across LAs, and are not driving our main results.

Specifically, we first estimate LA-specific linear time trends on all untreated observations. We then extrapolate these out for all years in our sample and include this estimated trend as a control in our model. By estimating these trends only on pre-treatment data, we avoid controlling for any impact that Sure Start itself has had on LA trends.²⁰ These estimates are presented in Appendix [Figure A.1](#) and are similar to our main estimates of [Figure 5](#).

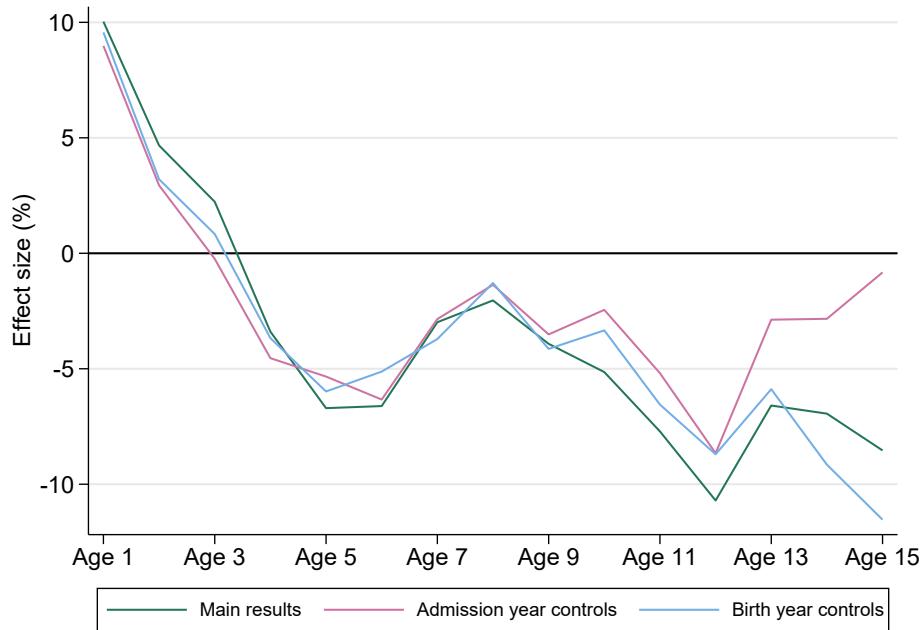
In Appendix [Table A.2](#) we additionally show that our estimates remain unchanged when we allow trends to differ by baseline LA characteristics rather than by individual LAs. Specifically, we control for trends in the official determinants of a faster expansion of the programme (1998 deprivation levels, teen conception rate and incidence of low birth weight). These estimates are similar in magnitude to our main results.

The parallel trends assumption also requires that there were no confounding shocks or policy changes correlated both with the roll-out of Sure Start and with hospitalisations. We therefore estimate a version of model 1 that includes a wide range of time-varying local area characteristics, including measures of other public services that changed over this period. We conduct two versions of this robustness check, measuring these local area characteristics either in the child's year of birth or contemporaneously in the year that the outcomes are measured. The former version tests for confounding variables that were tied to the Sure Start roll-out and may have influenced children's early health, such as the teen conception rate or the health service offer. The latter specification tests whether our estimates are confounded by a correlation between the rollout of Sure Start and subsequent changes in local characteristics or the local service offer, for example from policymak-

²⁰Given the relatively large effects that we estimate in our main model and the staggered roll-out of the programme, we would expect Sure Start to have a substantial impact on trends in hospitalisations post-implementation.

ers seeking to ‘follow up’ early intervention with later services. [Figure 6](#) shows that both of these robustness checks yield very similar results to our main estimates (though there are differences at age 15). We interpret the robustness of our results to this wide range of local characteristics as evidence that the internal validity of our research design is not compromised by most plausible confounders.

Figure 6: Sure Start’s effect on probability of any hospitalization, rescaled by baseline probability: Robustness to inclusion of time-varying controls



Note: Figure shows coefficients from separate regressions for each outcome age. Coefficients are rescaled by the baseline (1996) mean for each age. Specification including time-varying controls contains controls for: the teenage conception rate; the share of births with low birth weight; the total period fertility rate; the LA population density; the share of primary school students with English as an Additional Language; the rate of Children Looked After among infants and among children aged 1-4; the Jobseeker’s Allowance receipt rate; the number of GPs per capita in the LA; the number of JobcentrePlus per capita in the LA; and the take-up rate for funded childcare places for 3- and 4-year-olds in the LA. Vertical bars indicate 90% confidence intervals. Source: Authors’ calculations using data from the Hospital Episode Statistics inpatient data (1997-2017) and the Department for Education’s data on the rollout of Sure Start. Area characteristic sources are in Appendix B [Table B.1](#).

5.1.2 Sensitivity of the results to sample selection

As indicated at the bottom of [Table 3](#), the sample of analysis is not constant across outcomes. This is because we have sought to maximise our sample at each age, within constraints imposed

by the data and the need for comparability across cohorts.²¹ In order to check that our results are not driven by changes in the composition of the sample across ages, we re-estimate our main specification on two common cohorts. The first common cohort covers ages 1 to 4 and uses data for children born between April 1996 and December 2006. As Figure A.2 shows, the results on this early years cohort are virtually identical to our main estimates. The second common cohort covers ages 11 to 15 and uses data for children born between January 1993 and March 2002. Figure A.3 shows that the results on the common teen cohort are statistically indistinguishable from our main estimates.

5.1.3 Non-linearities in and age-dependence of treatment effects

Our main model assumes a linear effect of Sure Start coverage on children's hospitalisations. It may however be possible that the effect is non-linear, for example if there needs to be a critical mass of children exposed to Sure Start to start picking up effects on hospitalisations or if effects arise only once families have access to several centres in their vicinity. We explore this possibility by re-estimating our model to distinguish between no Sure Start coverage, medium coverage (fewer than 0.25 centres per thousand children), and high coverage (more than 0.25 centres per thousand).²²

Figure A.4 shows that the impacts of high coverage are of greater magnitude than the impacts of medium coverage, but other than at age 1, the impacts of medium and high coverage are statistically indistinguishable.

6 Mechanisms

In section 5 we showed that greater access to Sure Start increased the hospitalisations of infants and toddlers but reduced admissions among older children, particularly those in disadvantaged neighbourhoods. As discussed in section 3, given the variety of services offered by Sure Start,

²¹Many younger cohorts are not yet old enough to have data for hospitalisations at later ages. Further, since the inpatient data are only collected from 1997, some older cohorts will not be observed at younger ages.

²²The cut-off point between medium and high coverage is approximately the median coverage among those with positive coverage.

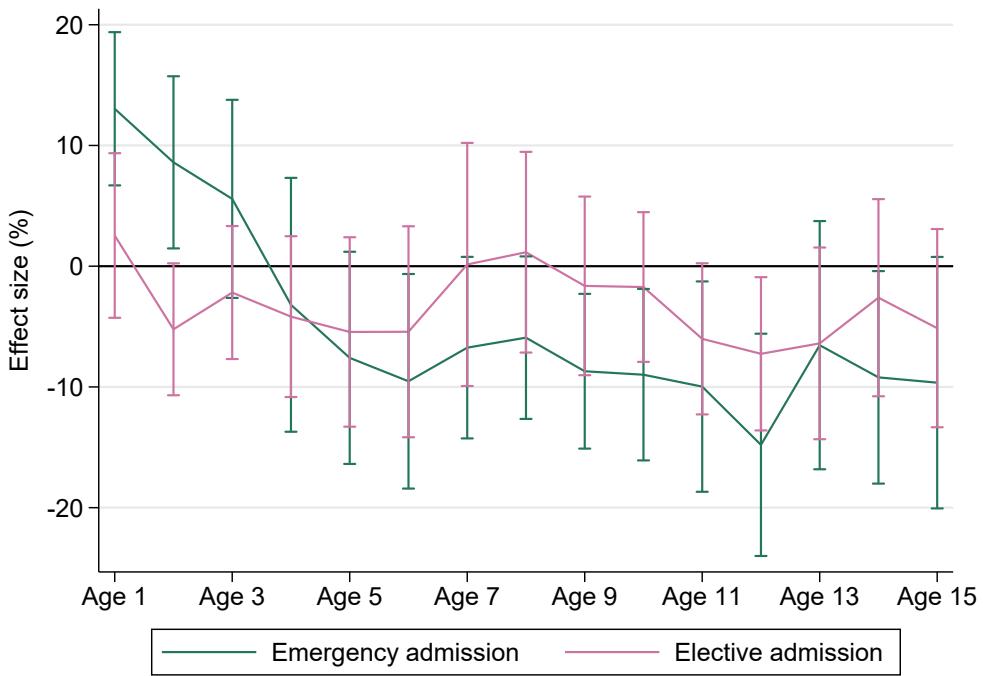
there are several potential mechanisms through which these effects might have arisen.

Because centre- or local authority-level data on the relative importance of these services across areas and over time was not systematically collected or retained, we are not able to provide direct evidence of the mechanisms underlying our main results. Instead, we provide two types of evidence. First, we analyse the impact of Sure Start on hospitalisations by different admission routes and for different causes. Following our discussion in [subsection 3.2](#), this can help us assess which mechanisms are most likely to underlie the results. Second, we use another dataset - the Labour Force Survey (LFS) - to directly estimate the impact of Sure Start on parental employment.

6.1 Admission route

We first examine whether effects are heterogeneity across the two possible routes through which patients can be admitted to hospital: via emergency and elective routes. The results are shown in [Figure 7](#) (underlying coefficients are presented in Appendix [Table A.4](#)). We find clear evidence that our overall results are driven by Sure Start's impacts on emergency admissions, with null effects on elective admissions for most ages. This suggests that Sure Start is affecting the incidence of illness or injury, not just families' propensity to seek health care for underlying or longer-term conditions. This is consistent with a wider effect of Sure Start beyond the provision of health services and information.

Figure 7: Sure Start's effect on probability of any hospitalisation, re-scaled by baseline probability: Emergency and elective admission routes



Note: Figure shows coefficients from separate regressions for each outcome age. Coefficients are re-scaled by the baseline (1996) mean for each age. Vertical bars indicate 90% confidence intervals. Source: Authors' calculations using data from the Hospital Episode Statistics inpatient data (1997-2017) and the Department for Education's data on the roll-out of Sure Start.

6.2 Cause-specific hospitalisations

To help understand what these wider effects could be, we next consider hospitalisations for a range of specific causes, focusing on conditions that are likely to result in emergency rather than elective admissions and that are most likely to have been affected by Sure Start: preventable conditions, infectious illnesses, external causes, and (among adolescents) mental health.²³ We measure preventable conditions as Ambulatory Care Sensitive (ACS) conditions, which include chronic conditions that can typically be managed outside of hospital (e.g. asthma); acute conditions where serious illness could have been prevented by early intervention (e.g. gangrene); and conditions

²³Hospital admissions in the HES data can have up to 20 causes, recorded via ICD-10 codes. In these results we classify admissions based on the primary diagnosis recorded; however, our results are similar when we instead look for any diagnosis matching the criteria.

that arise from vaccineable diseases (e.g. measles).²⁴ We present results graphically in [Figure 8](#) and refer the reader to Appendix [Table A.5](#) for tables containing point estimates and p-values adjusted for multiple hypothesis testing.

Starting with preventable (ACS) conditions, [Figure 8\(a\)](#) shows that Sure Start substantially increases hospitalisations for these conditions at younger ages, with a 20% increase over baseline levels at Age 1. However, as children age, greater access to Sure Start instead reduces ACS admissions, with a 20% *reduction* over baseline levels by age 11. This pattern is consistent with Sure Start providing better information and signposting, as parents learn to manage their child's conditions earlier in life and so reduce hospitalisations later on. This suggests that Sure Start is affecting the incidence of illness or injury, not just families' propensity to seek health care for underlying or longer-term conditions. This is consistent with a wider effect of Sure Start beyond the provision of health services and information.

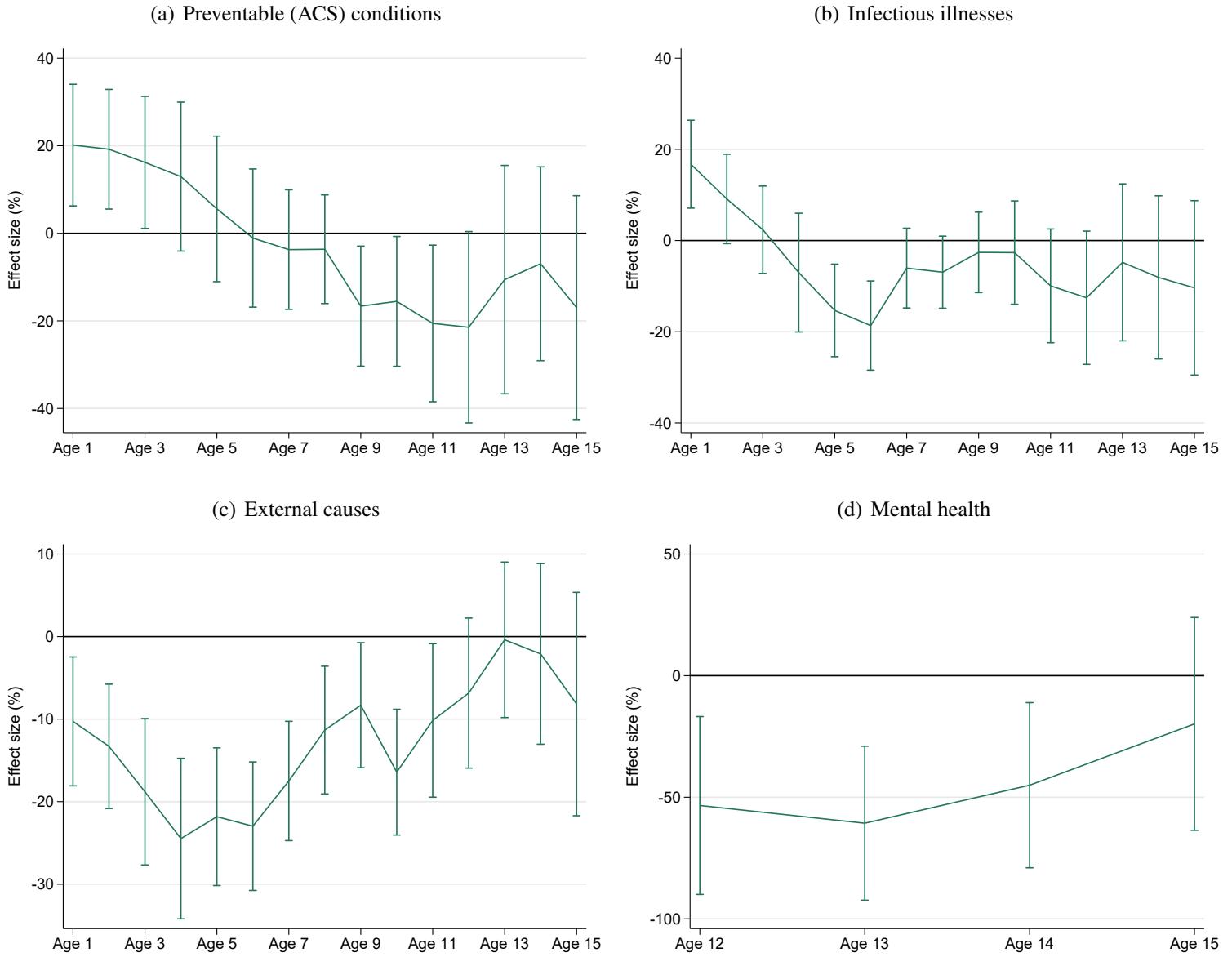
[Figure 8\(b\)](#) shows Sure Start's impacts on hospitalisations for any infectious illness (which include infectious and parasitic diseases and respiratory illness). We find that greater access to Sure Start substantially increases hospitalisations for infectious illnesses in infancy; however, there are significant and substantial falls in hospitalisations (of up to 18% of the baseline) at ages 5 and 6, just after children age out of Sure Start eligibility and start school. In line with the discussion in [subsection 3.2](#), the results presented here are consistent with exposure to pathogens through Sure Start activities such as childcare: children who are more exposed early in life are initially more vulnerable to infectious illness, but then build up a stronger immune response which protects them compared to their peers when the entire cohort enters school. These effects then fade out in the longer term, as the start of universal schooling sees other children's immune systems 'catch up'.

Next, we turn to hospitalisations for external causes.²⁵ [Figure 8\(c\)](#) shows that there is a very large, significant decline in hospitalisations for external causes at almost all ages we consider. Unlike the infectious outcomes discussed above, these effects are always negative; even at the youngest ages the probability of an externally caused hospitalisation falls by 10% or more with

²⁴See [Blunt \(2013\)](#) for a full list of ICD-10 codes that are included in this definition.

²⁵Those correspond to ICD-10 groups S, T, V and Y

Figure 8: Sure Start's effect on probability of hospitalisation for specific causes, re-scaled by baseline probability



Note: Figure shows coefficients from separate regressions for each outcome age. Coefficients are re-scaled by the baseline (1996) mean for each age. Vertical bars indicate 90% confidence intervals. Cause-specific results are based on the primary diagnosis at the time of admission. See Blunt (2013) for a list of all relevant ICD-10 codes included in ACS conditions. Infectious illnesses are composed of infectious and parasitic diseases (ICD-10 groups A and B) and respiratory illnesses (ICD-10 group J). External admissions include ICD-10 codes in groups S, T, V and Y. Mental health admissions relate to ICD-10 codes beginning with F.

greater access to Sure Start. At younger ages, these results offset some of the increase in hospitalisations due to infectious illnesses. However, unlike our main results, we find that the impact on

external admissions fades out at older ages, with null effects from age 12 onward.

We further analyse where the impacts on external conditions come from. Appendix [Table A.6](#) shows that greater access to Sure Start significantly reduces poisonings from ages 1 to 3, consistent with information about or direct provision of safer environments for young children. However, by far the main driver of reductions in hospitalisations for external causes is a reduction in injuries, which decline with greater access to Sure Start during almost all years in childhood.²⁶ We interpret the magnitude and persistence of these effects as potential evidence for sustained impacts on children's socio-emotional development and behaviour and/or reductions in child maltreatment.²⁷ Indeed, in Appendix [C](#) we show that having fewer externalising behaviour problems (such as aggression or hyperactivity) is correlated with a reduced probability of injury in middle childhood and early adolescence, even conditional on a wide range of demographics and family circumstances.

Lastly, we look directly at the impact of Sure Start on children's mental health. There are significant limitations to our data: we only observe hospital admissions, so our measure of mental health is very extreme and does not capture young people who are receiving services in the community, through their schools or through non-hospital providers. Previous work has also raised concerns about the accuracy of mental health diagnosis coding, especially for conditions such as depression or anxiety ([Davis, Sudlow and Hotopf, 2016](#)). Relatedly, recorded mental health hospitalisations among young people are very rare. Among children they are so rare, occurring in just 0.02% of cells, that we cannot estimate results. In [Figure 8\(d\)](#) (and Appendix [Table A.7](#)), we show the impact of additional access to Sure Start on mental health admissions among teenagers (ages 12 to 15). We find a statistically significant decrease in mental health-related admissions at ages 12 to 14, which is again consistent with potential longer-run impacts on children's socio-emotional development via enriched early environment and improved parenting practices.

²⁶Injuries (ICD-10 groups V and Y) account for between 70 and 80% of external admissions; most of the rest are accounted for by poisonings (codes T15-T98).

²⁷While previous research has identified a subset of conditions that can be used as proxies for potential maltreatment, the incidence of these is too low to reliably estimate Sure Start's impacts on these outcomes ([González-Izquierdo et al., 2010](#)). However, reductions in hospitalisations for injuries are commonly interpreted in the home visiting literature as signs of reductions in child maltreatment ([Kitzman et al., 1997](#)).

6.3 Sure Start's effects on parental employment

In addition to their focus on children's health and development, Sure Start centres also brought together existing services to support parental (especially maternal) employment. Children's Centres were required to develop links with JobcentrePlus, an existing network of government-run agencies to support the unemployed in finding work. Children's Centres were also required to signpost parents towards existing childcare programmes, most notably the entitlement to a part-time free childcare place for 3- and 4-year-olds.²⁸ Many Sure Start centres also offered information about further education and basic skills courses.

As discussed in [subsection 3.2](#), there are several channels through which an increase in parental employment resulting from Sure Start could affect children's hospitalisations. In order to tease out whether this is likely to be an important mechanism underlying our results, we use another dataset, the Labour Force Survey, to directly estimate whether increased Sure Start access had an effect on maternal labour market outcomes.

Unlike HES, the LFS is a survey collected in a staggered five-quarter rolling panel, with households entering the survey at different points in the year and then remaining in the sample for five consecutive quarters. As a result, we need to adapt our estimation strategy, though we aim to keep it as much in line as possible with the framework implemented in the HES data. Appendix [D](#) describes the data, estimation framework and presents the results. We find no evidence that Sure Start had an effect on maternal labour supply, whether measured while the mother had a child in age to be eligible to Sure Start services or beyond. We conclude from this analysis that it is unlikely that the effects we observe on children's hospitalisations are driven by an increase in maternal employment (and family income).

In sum, the expansion of Sure Start through the 2000s led to significant changes in the hospitalisations of children from infancy all the way to adolescence. At the youngest ages, greater access

²⁸The free entitlement was first introduced in 1997, offering a free childcare place to 4-year-olds for 12.5 hours per week, 33 weeks of the year. The programme was extended to cover 3-year-olds in April 2004, and the generosity of the system was increased in a series of reforms: by September 2010 it covered a 15-hour place for 38 weeks of the year.

to Sure Start increased hospitalisations, driven mainly by an increase in infectious illnesses. The increase was partly offset by a fall in hospitalisations from external causes and poisonings in the early years. Later, during early primary school, hospitalisations related to infectious illness fell. In later primary school years and early adolescence, we again observe a statistically fewer admissions to hospital for mental health reasons.

These patterns are consistent with Sure Start improving children's health and other dimensions of development through a number of key mechanisms: providing parents with greater information about children's health and healthcare; strengthening children's immune systems; improving children's behavioural and emotional development, by improving parenting practices and/or providing high-quality childcare. This evidence suggests that early childhood interventions focusing on these channels can deliver lasting health benefits, even in contexts with universal free health care.

7 Impact heterogeneity

The literature evaluating early childhood interventions often report the presence of heterogeneous impacts across different groups of children. We explore whether impacts of Sure Start on hospitalisations are heterogeneous by gender and by areas with different levels of deprivation. The latter dimension is particularly interesting when looking at the case of universal interventions, given on-going policy debates about the pros and cons of targeted vs. universal interventions.

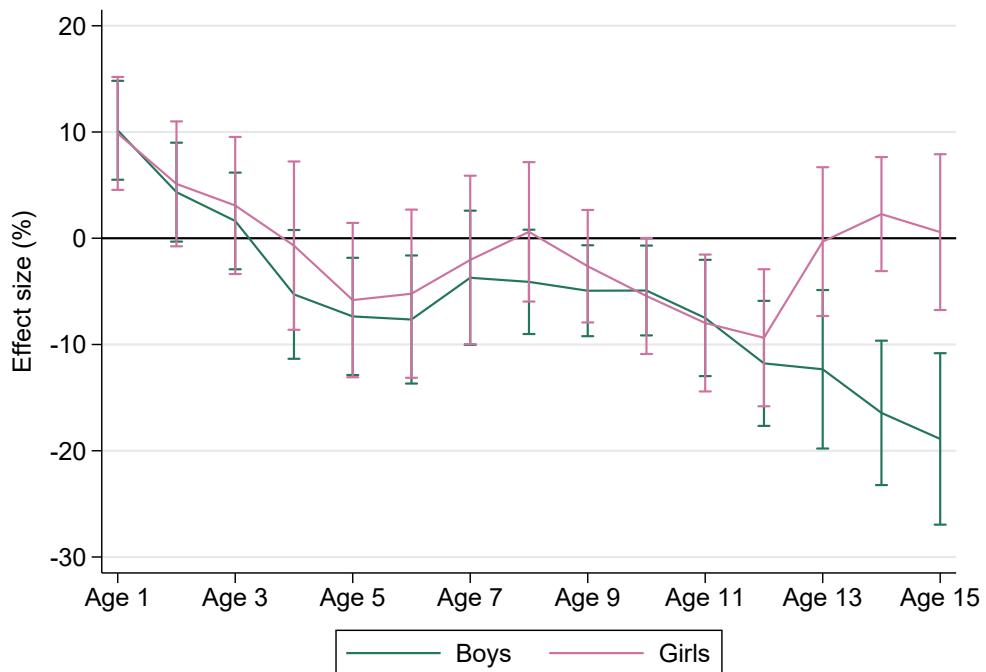
7.1 Heterogeneity by gender

Figure 9 (and the point estimates in Table A.8) shows how the effects of Sure Start on all-cause hospital admissions vary between girls and boys. The figure shows that the profile of effects is fairly similar for girls and boys up to age 10; however, during adolescence we find that the impacts diverge. While there is no impact on girls in their teen years, the impact on boys grows steadily. By age 15, an additional Sure Start centre per thousand children during the first five years of life reduces the probability of hospitalisation among boys by 20%, with no effect among girls.

The fact that Sure Start had greater impacts on boys in adolescence is consistent with the results

of early childhood intervention evaluations, such as the Abecedarian programme (Conti, Heckman and Pinto, 2016) and Head Start (Carneiro and Ginja, 2016). Interestingly, we find similar impacts for boys and girls early on; this suggests that the gender difference in impacts during adolescence is not due to differences in the take-up of services. Based on an analysis of gender-specific effects on hospitalisations for different causes (point estimates not reported), the gender difference in impacts is entirely driven by a greater impact of Sure Start on reducing hospitalisations for injuries, as highlighted in Figure 10.²⁹ Injury-related hospitalisations are more likely to happen for boys than for girls throughout childhood, with differences increasing from the age of 11, which would in turn reinforce the earlier suggestion that Sure Start did work by improving children's behaviour.

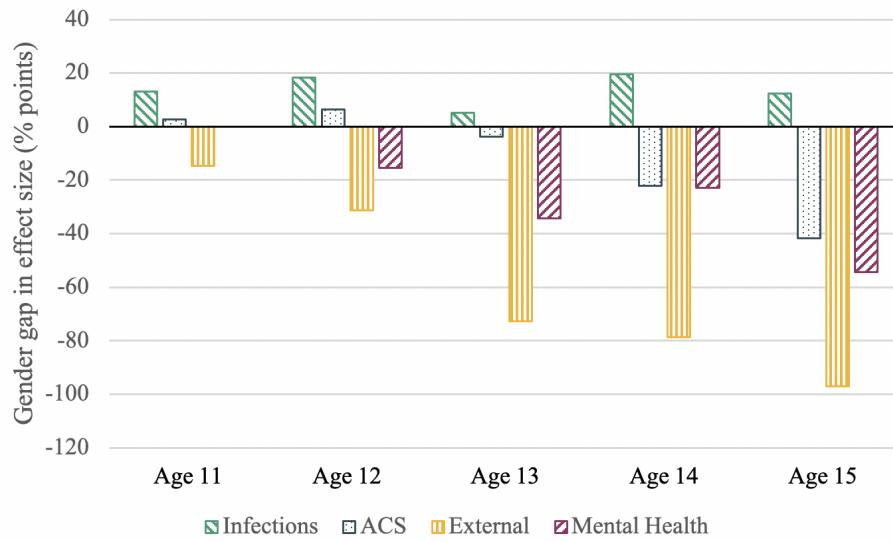
Figure 9: Sure Start's effect on probability of any hospitalisation, rescaled by baseline probability: Differences by gender



Note: The Figure shows coefficients from separate regressions for each outcome age, with Sure Start treatment interacted with gender. Coefficients are rescaled by the gender-specific baseline (1996) mean for each age. Vertical bars indicate 90% confidence intervals. Source: Authors' calculations using data from the Hospital Episode Statistics inpatient data (1997-2017) and the Department for Education's data on the rollout of Sure Start.

²⁹Injury-related admissions are the main component of external admissions.

Figure 10: Gender gap in Sure Start's effect on probability of any hospitalisation



Note: The Figure shows the percentage point difference the estimated effect size of Sure Start on the probability of hospitalisation between boys and girls. The difference in effect size between both genders is statistically significant at the 90% level at ages 11-12 for infections, age 15 for ACS and ages 11-15 for external. Original cause-specific point estimates and effect sizes by gender are not reported but available on request

7.2 Heterogeneity by level of deprivation

As we discussed in [section 2](#), Sure Start started as an intervention targeting highly disadvantaged areas, but the programme was universalised with the 2003 Every Child Matters initiative and the creation of a large network of Sure Start Children's Centres in most areas of the country. Despite its universal character, there are several reasons why we would not necessarily expect Sure Start to deliver the same benefits to all children.

First, the effectiveness of Sure Start will depend on the type of services and environment that children would have experienced otherwise. There is evidence to suggest that disadvantaged children grow up in less safe and stimulating environments and that disadvantaged parents make less use of healthcare ([Currie, 2006](#)). This means that disadvantaged families may have had more scope to benefit from the information and services to support parents that Sure Start provided.

There may also have been differences in the extent to which families made use of Sure Start services. This could be because families in some areas are more interested in using services (e.g.

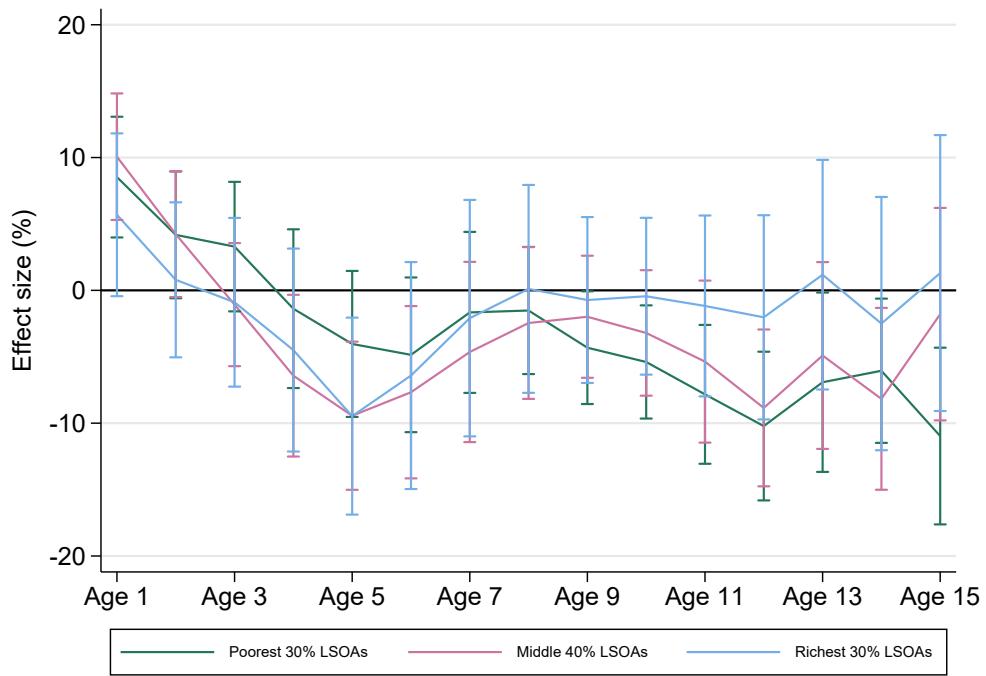
because they feel they can benefit more) or because centres in some areas do more in terms of outreach to attract families. Indeed, data collected by the ECCE project suggest that the poorest families spent somewhat more time in centres than other families ([Sammons, Goff and Smith, 2015](#)).

Finally, the impacts of Sure Start may differ between more and less advantaged neighbourhoods because of differences in the service offer. While all Sure Start Children's Centres had to deliver the 'Core Offer', SSCCs that opened in different phases of the expansion had different requirements in terms of the childcare offer they had to provide. All Phase 1 Children's Centres had to provide integrated early education and childcare for 0- to 4-year-olds, and there were strict requirements on the availability and quality of this care.³⁰ Phase 2 Centres also had to provide access to childcare, with a 0.5 full-time-equivalent qualified teacher post, though there was no target for new childcare places. Phase 3 Centres were not required to provide early learning and childcare places but could do so if the need arose ([House of Commons, 2010](#)).

For these diverse reasons, we would expect the impacts of Sure Start to be greater in more deprived areas, which would also be consistent with evidence from other large-scale early childhood interventions (see [Almond, Currie and Duque \(2018\)](#) for a review). We test whether this is the case by comparing the effect of Sure Start in the most disadvantaged 30% of neighbourhoods, the 30% least disadvantaged neighbourhoods, and those in the middle of the distribution of disadvantage. As [Figure 11](#) and [Table A.9](#) illustrate, the increase in admissions among infants detected for the whole sample in [Figure 5](#) is driven by those residing in neighbourhoods falling into the poorest 30% of the deprivation distribution. From ages 10 to 15, the drop in hospital admissions attributed to SS is even more concentrated in the areas with the highest levels of disadvantage, with imprecise impacts at the middle of the distribution (and zero effects at the top of the distribution).

³⁰The childcare offer was required to be available 10 hours a day, for 5 days each week and 48 weeks of the year. Centres were also required to appoint a qualified teacher and each local authority was given a target number of childcare places to create.

Figure 11: Sure Start's effect on probability of any hospitalisation, rescaled by baseline probability: Differences by disadvantage



Note: Figure shows coefficients from separate regressions for each outcome age, with Sure Start treatment interacted with the three disadvantage categories. Coefficients are rescaled by the deprivation-specific baseline (1996) mean for each age. Vertical bars indicate 90% confidence intervals.

8 Conclusion

In this paper we have presented the first causal evidence that a fully universal, scaled-up, area-based intervention which brings together education, employment, and health services for children under five and their families - Sure Start in England - has significant health benefits from infancy to adolescence. Using the staggered introduction and expansion of SS between 1999 and 2010, we trace out the program's impacts on health outcomes from ages 1 through 15.

We find that access to SS drives substantial effects on hospitalisations through several channels. At younger ages, when children are age-eligible to attend Sure Start, greater access to the program increases hospitalisations (especially due to infectious illnesses). Once children have aged out of the program, the overall effect on hospitalisations turns negative and the size of the reduction in

hospitalisations grows, more or less steadily, through later childhood and early adolescence. By adolescence, greater access to the program reduces the probability of a hospitalisation by 8% to 15%. Among 11- to 15-year-olds, these effects are equivalent to about 18,500 averted hospitalisations per year.

While we use strong quasi-experimental variation to identify these effects, there are several limitations to our approach. First, we rely on measures of very local geography to define our treatment and incorporate fixed effects. However, our data sources only offer contemporaneous information about residence. This means that we must assume that any mobility in the child's first years of life is unrelated to outcomes (conditional on our covariates); this rules out responses such as spatial sorting. A second limitation of our approach is that we are not able to define the impact of actually using Sure Start services (rather than simply having greater access to them). However, our Intent to Treat estimates are still of substantial relevance for policymakers choosing whether and how to introduce similar area-based interventions without the ability to ensure take-up of the services themselves.

These results build on the evidence base for early interventions; while there is good evidence for the benefits of small-scale, highly targeted, very intensive programs in contexts with relatively few other services, our findings suggest that universal, area-based, holistic interventions operating at scale can be an effective complement to universal health care and other social services for improving child health. Our results suggest that government policy should explicitly consider early interventions that span a range of health and non-health services as part of an overall strategy of preventing illness and disease; in particular, exposure to other children and better socio-emotional development may have health benefits that last into the medium term. Our findings also highlight the importance of assessing the impacts of these programs over time; while the short-term effect of Sure Start is to increase hospitalisations for infections, we find that there are persistent and growing medium-term reductions in hospital admissions that more than compensate for these earlier increases.

However, our results also suggest that this overall effectiveness of the Sure Start intervention

might have come despite, rather than because of, its universality. We find that our results are mainly driven by impacts in the 30% most disadvantaged neighbourhoods: these neighbourhoods see a larger increase in hospitalisations at younger ages, and larger falls during later childhood and adolescence. While the lack of detailed data on Sure Start's operation and take-up in different areas over time prevents us from drawing conclusions about why the program is so much more effective in poorer neighbourhoods, this finding nevertheless suggests that some form of targeting could be efficient in this intervention. However, this does not necessarily need to be targeting based on individual measures of disadvantage; rather, targeting centres at highly disadvantaged neighbourhoods could also help the program to be delivered more efficiently.

Overall, we estimate that the financial benefits from reduced hospitalisations offset approximately 24% of the provision cost of Sure Start. However, while this paper has focused on the Sure Start program's impacts on children's hospitalisations, the multifaceted nature of the program means that it could also have impacts and financial benefits on a wide range of other outcomes. In ongoing work, we are also considering the program's impacts on children's cognitive development (measured by test scores); their socio-emotional development and behaviour (measured by youth crime and absences from school); parenting and the home environment (measured by access to social services); and maternal health and employment. Of course, these are not only outcomes in their own right, but will also help to shed light on the mechanisms underlying the impacts we have shown on children's hospitalisations.

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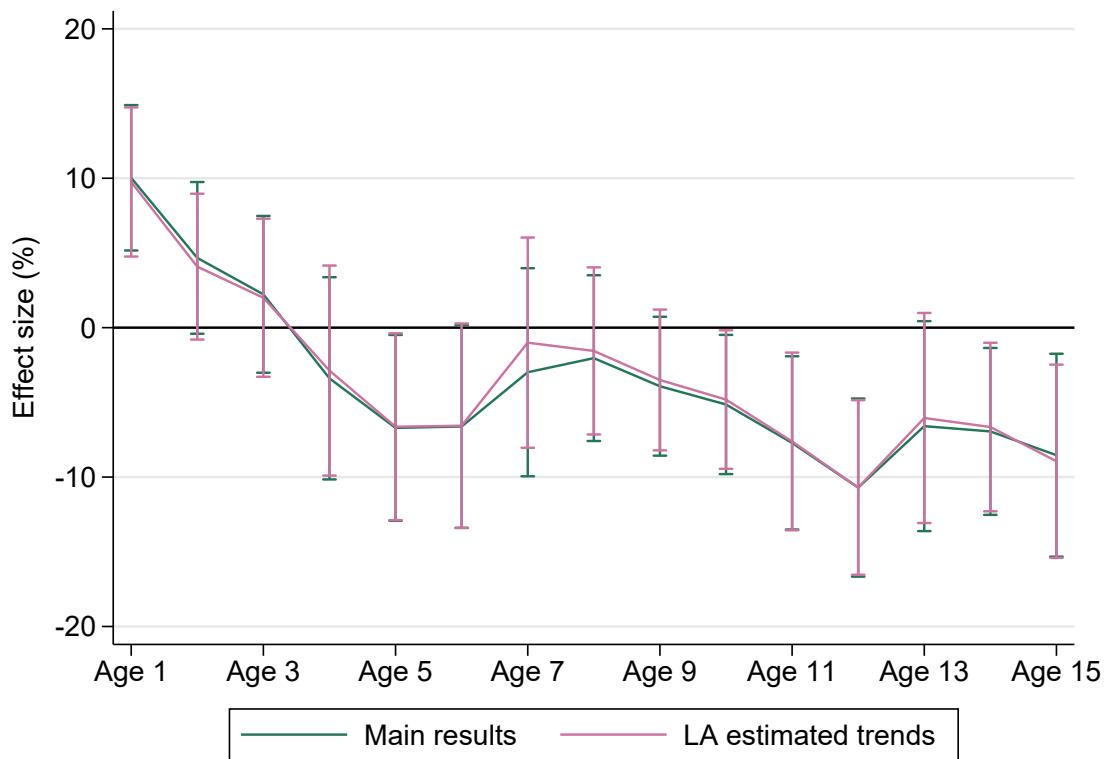
A Appendix Tables and Figures

Table A.1: Association between Sure Start coverage in 2010 and local characteristics

Dependent variable	(1) ΔSS_d	(2) ΔSS_d	(3) First Year	(4) First Year
<i>Official Rollout Determinants</i>				
Teen Conception Rate	0.00559* (1.88)	0.000229 (0.07)	-0.0882*** (-8.31)	-0.0710*** (-6.48)
% Low Birth Weight	0.0602** (2.04)	0.0239 (0.81)	-0.296*** (-2.81)	-0.334*** (-3.25)
<i>Deprivation Dummies</i>				
Bottom 20%	0.373*** (3.09)	-0.0444 (-0.29)	-2.620*** (-6.08)	-0.556 (-1.03)
20-30%	0.194 (1.53)	0.0166 (0.13)	-3.193*** (-7.05)	-2.162*** (-4.69)
30-70%	-0.00173 (-0.02)	-0.0239 (-0.32)	-1.488*** (-5.52)	-1.085*** (-4.12)
<i>Additional Predictors</i>				
Job Seekers Allowance		0.0707** (2.23)		-0.554*** (-5.00)
% population ages 0-4		19.87*** (4.02)		44.46** (2.57)
GP Practices/1000 pop		0.289 (0.55)		-2.585 (-1.40)
Proportion of children 0-4 looked after by LA		-0.000221 (-0.48)		0.00296* (1.84)
Proportion of 3 y.o. w/ access to funded childcare		0.552*** (2.91)		-1.023 (-1.54)
<i>N</i>	323	323	323	323

Note: ΔSS_d is the log of the difference in the number of centres (per thousand children aged 0-4) in 2010 and 2000 in each LA. First Year if the year the first Sure Start (Local Programme or Children Centre) opened in the Local Authority. Deprivation deciles come from the 1998 Index of Local Deprivation. Low birth weight is the share of babies born weighing less than 2,500 grams. Teen conceptions are measured per thousand women aged 15-17. Jobseeker Allowance is the JSA receipt rate. All characteristics are measured in 1998. Source: Authors' calculations using data provided by the Department for Education and the sources listed in [Table B.1](#) in the Appendix.

Figure A.1: Sure Start's effect on probability of any hospitalisation, re-scaled by baseline probability: Baseline estimates and controlling for linear local authority trends



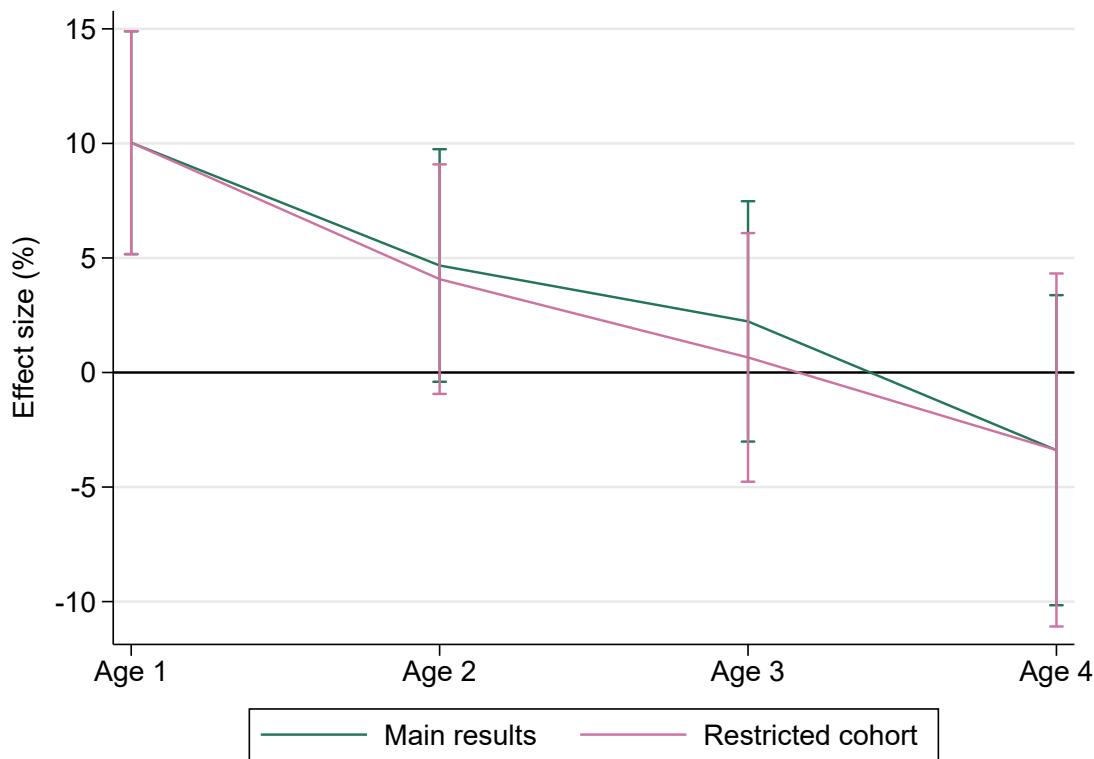
Note: Effect sizes are constructed by re-scaling the estimates by the pre-Sure Start baseline probability of a hospitalisation at each age. Vertical bars indicate 90% confidence intervals. Results with LAD estimated trends additionally control for a local authority-specific linear time trend, estimated based on pre-treatment hospitalisation data for each LA. Source: Authors' calculations using data from the Hospital Episode Statistics inpatient data (1997-2017) and the Department for Education's data on the roll-out of Sure Start.

Table A.2: Effect of an increase in Sure Start coverage on probability of hospitalisation for any cause: Robustness to inclusion of linear trends in baseline characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15
<i>Panel A: Main Specification</i>															
SS Cov	0.0256*** (0.0075)	0.0095 (0.0063)	0.0040 (0.0057)	-0.0057 (0.0069)	-0.0109* (0.0061)	-0.0095 (0.0059)	-0.0038 (0.0053)	-0.0024 (0.0039)	-0.0044 (0.0032)	-0.0055* (0.0031)	-0.0084** (0.0038)	-0.0125*** (0.0042)	-0.0081 (0.0052)	-0.0091** (0.0045)	-0.0120** (0.0058)
Baseline mean	0.2552	0.2044	0.1791	0.1687	0.1623	0.1438	0.1260	0.1160	0.1125	0.1078	0.1089	0.1172	0.1229	0.1311	0.1410
<i>Panel B: controlling for conception rate only</i>															
SS Cov	0.0308*** (0.0096)	0.0159** (0.0073)	0.0043 (0.0070)	-0.0104 (0.0086)	-0.0137* (0.0070)	-0.0105 (0.0070)	-0.0054 (0.0064)	-0.0042 (0.0048)	-0.0064 (0.0039)	-0.0059 (0.0038)	-0.0096** (0.0046)	-0.0121** (0.0053)	-0.0099 (0.0067)	-0.0097 (0.0064)	-0.0079 (0.0053)
Baseline mean	0.196** (0.0077)	0.0079 (0.0063)	-0.0003 (0.0059)	-0.0088 (0.0074)	-0.0125* (0.0065)	-0.0088 (0.0064)	-0.0027 (0.0059)	-0.0013 (0.0044)	-0.0016 (0.0035)	-0.0023 (0.0032)	-0.0046 (0.0041)	-0.0078* (0.0042)	-0.0043 (0.0053)	-0.0069 (0.0050)	-0.0041 (0.0052)
<i>Panel C: controlling for deprivation (ild 1998) dummies only</i>															
SS Cov	0.0191** (0.0089)	0.0030 (0.0072)	-0.0027 (0.0063)	-0.0149*** (0.0073)	-0.0186*** (0.0063)	-0.0154*** (0.0062)	-0.0089 (0.0056)	-0.0073* (0.0042)	-0.0073* (0.0035)	-0.0082** (0.0034)	-0.0106** (0.0034)	-0.0144*** (0.0042)	-0.0101* (0.0045)	-0.0122** (0.0058)	-0.0106 (0.0050)
Baseline mean	0.2552	0.2044	0.1791	0.1687	0.1623	0.1438	0.1260	0.1160	0.1125	0.1078	0.1089	0.1172	0.1229	0.1311	0.1410
N	2822176	3084704	3347232	3609760	3675392	3675392	3675392	3675392	3675392	3675392	3478496	3215968	2953440	2690912	2428384

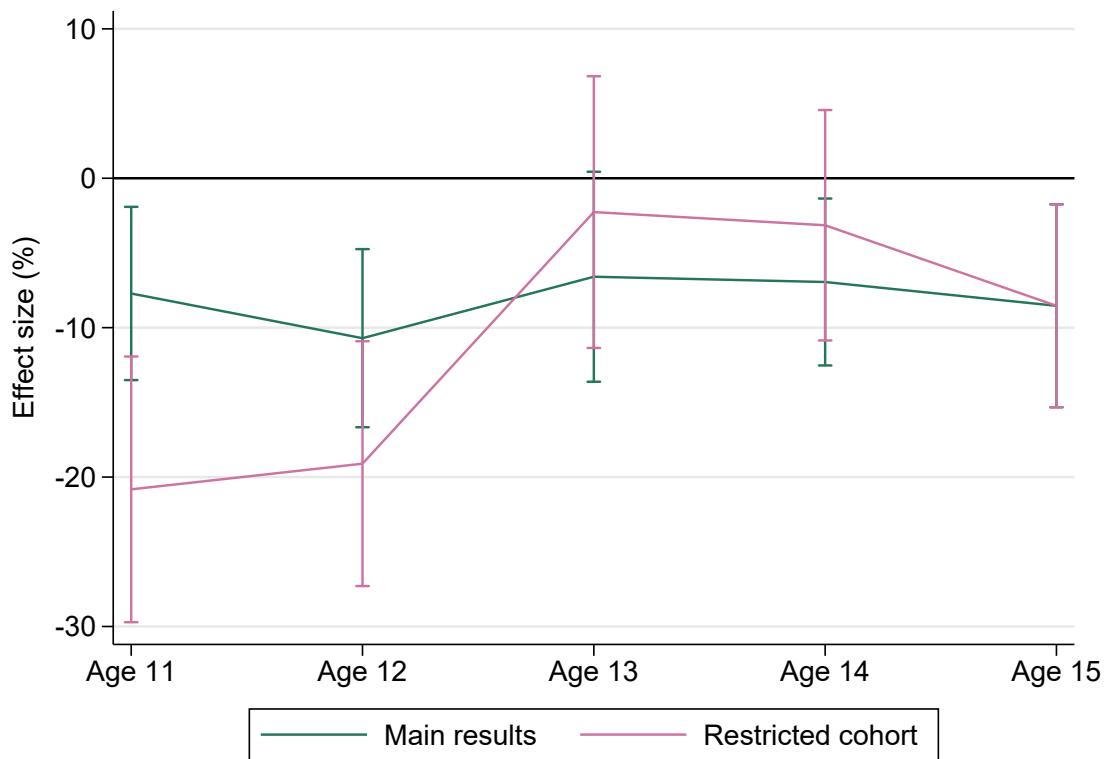
Note: XXX*, ** and *** indicate significance at the 10%, 5% and 1% level respectively.

Figure A.2: Sure Start's effect on probability of any hospitalisation, re-scaled by baseline probability: Baseline estimates and estimates on a common cohort for 1- to 4-year-olds



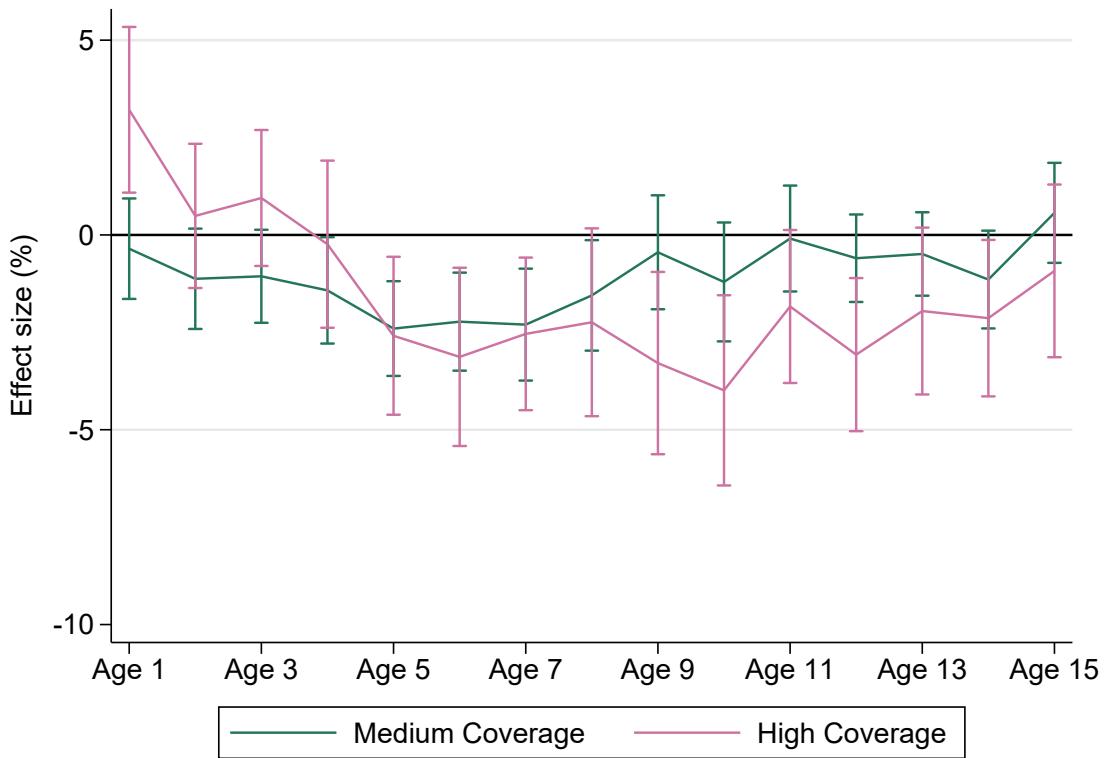
Note: Figure shows coefficients from separate regressions for each outcome age. Coefficients are re-scaled by the baseline (1996) mean for each age. Main results are estimated on cohorts as listed in [Table 3](#). Common cohort results use a cohort of children born between April 1996 and December 2006. Vertical bars indicate 90% confidence intervals. Source: Authors' calculations using data from the Hospital Episode Statistics inpatient data (1997-2017) and the Department for Education's data on the roll-out of Sure Start.

Figure A.3: Sure Start's effect on probability of any hospitalisation, re-scaled by baseline probability: Baseline estimates and estimates on a common cohort for 1- to 4-year-olds



Note: Figure shows coefficients from separate regressions for each outcome age. Coefficients are re-scaled by the baseline (1996) mean for each age. Main results are estimated on cohorts as listed in [Table 3](#). Common cohort results use a cohort of children born between January 1993 and March 2002. Vertical bars indicate 90% confidence intervals. Source: Authors' calculations using data from the Hospital Episode Statistics inpatient data (1997-2017) and the Department for Education's data on the roll-out of Sure Start.

Figure A.4: Sure Start's effect on probability of any hospitalisation, re-scaled by baseline probability: Non-linear estimates



Note: Figure shows coefficients from separate regressions for each outcome age. Treatment is a pair of indicators for whether the cell experienced medium treatment (strictly positive coverage, but less than 0.25 centres per thousand children) or high treatment (more than 0.25 centres per thousand children). The omitted category is low treatment (untreated). Coefficients are re-scaled by the baseline (1996) mean for each age. Results marked with a star are significant at the 5% level. Source: Authors' calculations using data from the Hospital Episode Statistics inpatient data (1997-2017) and the Department for Education's data on the roll-out of Sure Start.

Table A.3: Effect of an increase in the lead value of Sure Start coverage on the probability of hospitalisation for any cause: 16 quarterly leads

	(1) Age 1	(2) Age 2	(3) Age 3	(4) Age 4	(5) Age 5	(6) Age 6	(7) Age 7	(8) Age 8	(9) Age 9	(10) Age 10	(11) Age 11	(12) Age 12	(13) Age 13	(14) Age 14	(15) Age 15
3 months lead	-0.749 (-1.49)	0.322 (0.74)	0.0134 (0.04)	0.141 (0.38)	0.280 (0.86)	-0.380 (-1.19)	-0.330 (-0.94)	-0.751** (-2.46)	-0.0453 (-0.14)	0.0697 (0.24)	-0.0285 (-0.31)	0.00830 (0.09)	-0.278*** (-2.93)	-0.158 (-1.39)	-0.0215 (-0.11)
6 months lead	0.367 (0.82)	-0.246 (-0.70)	0.657** (2.00)	0.289 (1.01)	-0.236 (-0.84)	-0.0493 (-0.20)	0.0179 (0.07)	-0.874*** (-3.79)	-0.231 (-0.89)	0.155 (0.70)	-0.0733 (-1.17)	0.0390 (0.65)	0.124** (2.07)	0.123 (1.52)	-0.0323 (-0.25)
9 months lead	0.0591 (0.20)	0.444* (1.69)	0.0827 (0.30)	0.0645 (0.80)	-0.00257 (-0.04)	0.0164 (0.22)	0.0710 (1.10)	-0.0179 (-0.25)	-0.0130 (-0.19)	0.0125 (0.19)	0.0347 (0.85)	0.0705 (1.48)	-0.0915* (-1.74)	-0.0359 (-0.55)	-0.0596 (-0.55)
12 months lead	-0.0156 (-0.07)	0.170 (1.09)	-0.0938 (-1.63)	-0.0515 (-1.26)	-0.0547* (-1.65)	-0.0128 (-0.35)	-0.00862 (-0.32)	-0.0245 (-0.75)	0.0187 (0.65)	-0.0148 (-0.51)	0.0375* (1.89)	-0.0465 (-1.11)	0.0684 (1.51)	-0.0842 (-1.44)	0.0579 (0.59)
15 months lead	0.0219 (0.13)	0.0281 (1.25)	0.0621*** (2.70)	0.0262 (1.28)	0.00960 (0.52)	0.00196 (0.10)	0.0225 (1.36)	0.0231 (1.18)	-0.00182 (-0.13)	-0.0120 (-0.78)	-0.0257* (-1.77)	-0.00776 (-0.46)	-0.0234 (-0.74)	0.0491 (0.85)	0.00372 (0.04)
18 months lead	0.0659** (2.22)	-0.0122 (-0.64)	0.00934 (0.50)	-0.0340* (-1.94)	-0.0235 (-1.56)	-0.00453 (-0.26)	0.0174 (1.29)	-0.0109 (-0.82)	-0.00388 (-0.31)	0.00578 (0.42)	-0.00729 (-0.63)	-0.00115 (-0.10)	0.00116 (0.07)	-0.00306 (-0.08)	0.0616 (0.70)
21 months lead	0.00580 (0.23)	0.00443 (0.25)	0.00683 (0.41)	0.0210 (1.35)	-0.00199 (-0.13)	0.00384 (0.30)	0.00262 (0.24)	-0.00716 (-0.59)	0.0202* (1.84)	-0.0122 (-0.95)	-0.00255 (-0.24)	-0.00425 (-0.38)	-0.0191 (-1.40)	0.00230 (0.12)	-0.115 (-1.41)
24 months lead	0.0340 (1.35)	0.0297 (1.58)	0.0436*** (2.71)	-0.00206 (-0.14)	0.0134 (1.12)	-0.0164 (-1.19)	0.0190 (1.59)	0.0134 (1.30)	0.00468 (0.42)	0.00760 (0.63)	0.00619 (0.64)	-0.00378 (-0.34)	-0.00126 (-0.10)	0.0195 (1.32)	0.0336 (1.29)
27 months lead	0.0466** (2.02)	0.00904 (0.55)	0.0309** (2.01)	0.00784 (-0.55)	-0.0152 (-1.05)	0.0133 (1.24)	0.0127 (1.06)	-0.00870 (-0.83)	0.00652 (0.61)	-0.0161 (-1.59)	-0.0133 (-1.39)	-0.0130 (-1.25)	-0.00873 (-0.77)	0.0143 (1.00)	0.0203 (0.87)
30 months lead	0.00892 (0.43)	0.00958 (0.61)	0.0158 (0.96)	0.00567 (0.49)	0.000624 (0.05)	-0.00406 (-0.37)	0.0140 (1.39)	-0.00474 (-0.55)	0.00361 (0.37)	0.00295 (0.31)	-0.00127 (-0.14)	-0.00783 (-0.86)	-0.00324 (-0.31)	0.0105 (0.81)	0.0532 (0.31)
33 months lead	2.242** (2.14)	-0.0133 (-0.94)	0.0308** (2.15)	0.000917 (0.07)	0.00420 (0.34)	0.00847 (0.89)	0.0205** (2.03)	0.00593 (0.60)	0.00995 (1.12)	-0.00800 (-0.78)	-0.00502 (-0.64)	0.00264 (0.34)	-0.00610 (-0.65)	-0.00415 (-0.03)	0.0377 (0.27)
36 months lead	0.397 (0.81)	-0.577 (-0.75)	0.0289** (2.59)	0.00118 (0.11)	-0.00748 (-0.75)	-0.00731 (-0.80)	0.0134 (1.50)	0.00327 (0.37)	0.00836 (1.04)	-0.00223 (-0.27)	0.00532 (0.79)	-0.0163** (-2.23)	0.146 (1.56)	-0.0288 (-0.27)	0.112 (0.94)
39 months lead	-0.408 (-0.93)	-0.240 (-0.54)	-1.140* (-1.70)	0.00861 (0.76)	-0.00319 (-0.30)	0.00213 (0.24)	0.0254*** (2.63)	0.0115 (1.37)	0.0101 (1.30)	0.000614 (0.07)	-0.00879 (-1.30)	-0.120 (-1.29)	-0.103 (-1.59)	-0.0441 (-0.49)	-0.126 (-1.24)
42 months lead	0.108 (0.42)	0.205 (0.62)	0.0149 (0.04)	0.104 (0.14)	-1.177* (-1.77)	-0.0859 (-0.13)	1.604*** (2.59)	0.992* (1.70)	-0.330 (-0.50)	0.0519 (0.10)	0.0586 (0.66)	0.0105 (0.16)	0.0792 (1.35)	0.171** (2.49)	0.00812 (0.09)
45 months lead	0.00421 (0.02)	-0.438* (-1.88)	-0.562* (-1.83)	-0.330 (-0.96)	-0.118 (-0.38)	0.270 (0.84)	0.105 (0.32)	0.938*** (3.29)	0.184 (0.59)	-0.165 (-0.54)	0.0643 (0.88)	-0.0955** (-2.02)	-0.113** (-2.21)	-0.0775 (-1.22)	-0.0846 (-0.91)
48 months lead	-0.0453 (-0.29)	-0.144 (-1.14)	0.0742 (0.30)	-0.197 (-0.79)	0.247 (0.96)	0.0101 (0.04)	-0.0488 (-0.20)	0.612*** (2.75)	0.177 (0.76)	-0.0834 (-0.43)	-0.0678* (-1.65)	0.0264 (0.69)	0.0282 (0.77)	0.00438 (0.10)	0.153* (1.76)
N	330904	456612	638934	836016	901648	901648	901648	901648	901648	901648	901188	884722	853652	813808	738908
pvalue	0.0223	0.0014	0.0000	0.0594	0.1121	0.3355	0.0032	0.0016	0.9173	0.9539	0.5078	0.1737	0.2554	0.0305	0.1557

Notes: The table shows coefficients for regression analyses at each outcome age. Observations are cells defined by the LSOA, year of birth, and sex. The model regresses an indicator for any hospitalization in a cell on 16 quarterly lags of the Sure Start coverage, the population at the relevant age in the LSOA and an indicator for female and includes fixed effects for year birth and the LSOA of residence. Sure Start coverage is defined as the number of centres per thousand children aged 0–4 in the local authority for outcomes at age 5 and older; when studying outcomes for younger ages, $a = 1, \dots, 4$, SS_{qd} is defined the number of centres per thousand children aged 0–4 that were open in the LA d when the child was aged $a - 1$. The baseline mean is measured in 1996. Standard errors are shown in parentheses clustered by LAD.

[h]

Table A.4: Effect of an increase in Sure Start coverage on probability of hospitalization: By admission route

	(1) Age 1	(2) Age 2	(3) Age 3	(4) Age 4	(5) Age 5	(6) Age 6	(7) Age 7	(8) Age 8	(9) Age 9	(10) Age 10	(11) Age 11	(12) Age 12	(13) Age 13	(14) Age 14	(15) Age 15	
<i>Panel A: Emergency admissions</i>																
SS Cov	0.0276*** (0.0082)+++	0.0132** (0.0066)	0.0063 (0.0056)	-0.0029 (0.0057)	-0.0060 (0.0042)	-0.0065* (0.0037)	-0.0042 (0.0028)	-0.0037 (0.0026)	-0.0056** (0.0025)	-0.0037 (0.0028)	-0.0057** (0.0028)	-0.0064* (0.0034)	-0.0101*** (0.0038)++	-0.0045 (0.0043)	-0.0069* (0.0040)	-0.0079 (0.0052)
Baseline mean	0.2118	0.1531	0.1132	0.0897	0.0789	0.0677	0.0623	0.0627	0.0646	0.0639	0.0639	0.0681	0.0692	0.0753	0.0817	
<i>Panel B: Elective admissions</i>																
SS Cov	0.0019 (0.0031)	-0.0039 (0.0025)	-0.0019 (0.0029)	-0.0041 (0.0040)	-0.0055 (0.0048)	-0.0049 (0.0048)	0.0001 (0.0046)	0.0007 (0.0032)	-0.0009 (0.0026)	-0.0009 (0.0020)	-0.0033 (0.0021)	-0.0044* (0.0023)	-0.0042 (0.0023)	-0.0018 (0.0032)	-0.0039 (0.0035)	-0.0038 (0.0038)
Baseline mean	0.0741	0.0753	0.0875	0.0982	0.1014	0.0909	0.0756	0.0641	0.0583	0.0539	0.0556	0.0606	0.0664	0.0697	0.0756	
N	2822176	3084704	3347232	3609760	3675392	3675392	3675392	3675392	3675392	3675392	3675392	3478496	3215968	2953440	2690912	2428384
Earliest cohort	apr.96 des.06	apr.95 des.06	apr.94 des.06	apr.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 mar.05	jan.93 mar.04	jan.93 mar.03	jan.93 mar.02	

Note: See notes to [Table 3](#). Emergency admission routes include emergency room services or emergency referrals from GPs; elective admissions include planned inpatient care. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively; +, ++ and + + + indicate significance at the 10%, 5% and 1% level, respectively, after adjusting inference following the procedure in algorithms 4.1 and 4.2 of [Romano and Wolf \(2005\)](#).

Table A.5: Effect of an increase in Sure Start coverage on probability of hospitalization due to specific conditions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15
<i>Panel A: Any hospitalisation for infectious illnesses</i>															
SS Cov	0.0202*** (0.0071)	0.0074 (0.0048)	0.0015 (0.0037)	-0.0035 (0.0039)	-0.0071** (0.0029)	-0.0067*** (0.0021)	-0.0017 (0.0015)	-0.0016 (0.0011)	-0.0006 (0.0012)	-0.0005 (0.0013)	-0.0016 (0.0012)	-0.0020 (0.0014)	-0.0007 (0.0015)	-0.0011 (0.0015)	-0.0015 (0.0017)
Baseline mean	0.1208	0.0808	0.0635	0.0494	0.0466	0.0361	0.0275	0.0231	0.0225	0.0187	0.0160	0.0159	0.0145	0.0136	0.0147
<i>Panel B: Any hospitalisation for ACS related cause</i>															
SS Cov	0.0123*** (0.0051)	0.0072** (0.0031)	0.0038* (0.0022)	0.0021 (0.0017)	0.0007 (0.0013)	-0.0001 (0.0010)	-0.0003 (0.0007)	-0.0003 (0.0007)	-0.0013** (0.0008)	-0.0013* (0.0008)	-0.0016* (0.0008)	-0.0016 (0.0010)	-0.0008 (0.0011)	-0.0005 (0.0009)	-0.0013 (0.0012)
Baseline mean	0.0609	0.0375	0.0235	0.0162	0.0129	0.0101	0.0089	0.0093	0.0092	0.0086	0.0076	0.0075	0.0072	0.0071	0.0079
<i>Panel C: Any hospitalisation for an external cause</i>															
SS Cov	-0.0041*** (0.0019)+	-0.0052*** (0.0018)++	-0.0057*** (0.0016)++	-0.0062*** (0.0015)+++	-0.0056*** (0.0013)+++	-0.0056*** (0.0012)+++	-0.0040*** (0.0010)+++	-0.0024*** (0.0010)++	-0.0017* (0.0010)++	-0.0017* (0.0010)+++	-0.0023* (0.0013)	-0.0023* (0.0014)	-0.0018 (0.0013)	-0.0001 (0.0017)	-0.0007 (0.0022)
Baseline mean	0.0397	0.0395	0.0305	0.0255	0.0257	0.0245	0.0227	0.0214	0.0207	0.0218	0.0231	0.0260	0.0291	0.0335	0.0357
N	2822176	3084704	3347232	3609760	3675392	3675392	3675392	3675392	3675392	3675392	3478496	3215968	2933440	2690912	2428384
Earliest cohort	apr.96 des.06	apr.95 des.06	apr.94 des.06	apr.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 mar.05	jan.93 mar.06	jan.93 mar.05	jan.93 mar.04	jan.93 mar.02

Note: See notes to Table 3. Cause-specific results are based on the primary diagnosis at the time of admission. External admissions include ICD-10 codes in groups S, T, V and Y. Poisonings include ICD-10 codes T15-T98, while injuries include codes V01-Y98. FRACTURES & HEAD INJURIES? *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively; +, ++ and +++ indicate significance at the 10%, 5% and 1% level, respectively, after adjusting inference following the procedure in algorithms 4.1 and 4.2 of Romano and Wolf (2005). (NOT DONE FOR PANELS A AND B)

Table A.6: Effect of an increase in Sure Start coverage on probability of hospitalization due to specific conditions

	(1) Age 1	(2) Age 2	(3) Age 3	(4) Age 4	(5) Age 5	(6) Age 6	(7) Age 7	(8) Age 8	(9) Age 9	(10) Age 10	(11) Age 11	(12) Age 12	(13) Age 13	(14) Age 14	(15) Age 15	
<i>Panel A: Any hospitalisation for poisoning</i>																
SS Cov	-0.0033*** (0.0011)++	-0.0025** (0.0012)++	-0.0024** 2.4 (0.0007)	-0.0008 (0.0006)	-0.0002 (0.0004)	-0.0001 (0.0003)	-0.0004 (0.0003)	0.0003 (0.0003)	0.0006* (0.0003)	-0.0003 (0.0003)	0.0003 (0.0003)	0.0006 (0.0005)	0.0004 (0.0005)	0.0015 (0.0014)	-0.0009 (0.0019)	
Baseline mean	0.0187	0.0188	0.0114	0.0070	0.0058	0.0046	0.0039	0.0034	0.0031	0.0028	0.0031	0.0041	0.0065	0.0110	0.0139	
<i>Panel B: Any hospitalisation for injuries</i>																
SS Cov	-0.0010 (0.0012)	-0.0030** (0.0012)++	-0.0033*** (0.0010)+++	-0.0056*** (0.0013)+++	-0.0054*** (0.0011)+++	-0.0055*** (0.0010)+++	-0.0035*** (0.0009)+++	-0.0026*** (0.0009)+++	-0.0022*** (0.0009)+++	-0.0033*** (0.0010)+++	-0.0026*** (0.0013)	-0.0024* (0.0014)	-0.0006 (0.0014)	-0.0018 (0.0018)	-0.0027 (0.0022)	
Baseline mean	0.0216	0.0214	0.0194	0.0187	0.0201	0.0200	0.0189	0.0181	0.0178	0.0191	0.0202	0.0221	0.0230	0.0232	0.0227	
<i>Panel C: Any hospitalisation for fractures</i>																
SS Cov	-0.0007* (0.0004)	-0.0009** (0.0004)	-0.0007* (0.0004)	-0.0008 (0.0006)	-0.0016*** (0.0005)	-0.0028*** (0.0006)	-0.0009* (0.0005)	-0.0012** (0.0005)	-0.0013*** (0.0005)	-0.0013*** (0.0005)	-0.0018*** (0.0007)	-0.0010 (0.0007)	0.0005 (0.0009)	0.0008 (0.0010)	0.0005 (0.0013)	
Baseline mean	0.0054	0.0065	0.0068	0.0080	0.0101	0.0111	0.0108	0.0100	0.0102	0.0115	0.0121	0.0130	0.0138	0.0134	0.0119	
<i>Panel D: Any hospitalisation for head injuries</i>																
SS Cov	-0.0007 (0.0008)	-0.0016* (0.0008)	-0.0010 (0.0006)	-0.0023*** (0.0007)	-0.0019*** (0.0006)	-0.0005 (0.0004)	-0.0006* (0.0004)	-0.0007 (0.0004)	-0.0006** (0.0003)	-0.0006** (0.0003)	0.0000 (0.0004)	-0.0005 (0.0005)	-0.0004 (0.0005)	-0.0011 (0.0007)	-0.0017* (0.0009)	
Baseline mean	0.0084	0.0079	0.0066	0.0052	0.0046	0.0037	0.0031	0.0029	0.0028	0.0029	0.0031	0.0038	0.0044	0.0049	0.0051	
N	2822176	3084704	3347232	3609760	3675392	3675392	3675392	3675392	3675392	3675392	3675392	3478496	3215968	2953440	2690912	2428384
Earliest cohort	apr.96 des.06	apr.95 des.06	apr.94 des.06	apr.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 mar.05	jan.93 mar.04	jan.93 mar.03	jan.93 mar.02	

Note: See notes to [Table 3](#). Cause-specific results are based on the primary diagnosis at the time of admission. External admissions include ICD-10 codes in groups S, T, V and Y. Poisonings include ICD-10 codes T15-T98, while injuries include codes V01-Y98. FRACTURES & HEAD INJURIES? *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively; +, ++ and +++ indicate significance at the 10%, 5% and 1% level, respectively, after adjusting inference following the procedure in algorithms 4.1 and 4.2 of [Romano and Wolf \(2005\)](#). (NOT DONE FOR PANELS C AND D)

Table A.7: Effect of an increase in Sure Start coverage on probability of hospitalization for mental health

	(1) Age 11	(2) Age 12	(3) Age 13	(4) Age 14	(5) Age 15
SS Cov	-0.0003 (0.0002)	-0.0007** (0.0003)++	-0.0016*** (0.0005)+++	-0.0019** (0.0009)++	-0.0010 (0.0013)
Baseline mean	0.0007	0.0013	0.0026	0.0042	0.0049
N	3478496	3215968	2953440	2690912	2428384
Earliest cohort	jan.93	jan.93	jan.93	jan.93	jan.93
Latest cohort	mar.06	mar.05	mar.04	mar.03	mar.02

Note: See notes to [Table 3](#). Cause-specific results are based on the primary diagnosis at the time of admission. Mental health admissions are based on ICD-10 group F. Results for younger ages are omitted because of very low prevalence. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively; +, ++ and +++ indicate significance at the 10%, 5% and 1% level, respectively, after adjusting inference following the procedure in algorithms 4.1 and 4.2 of [Romano and Wolf \(2005\)](#).

Figure A.5: Hours spent per week at different Sure Start services by family income, 2011

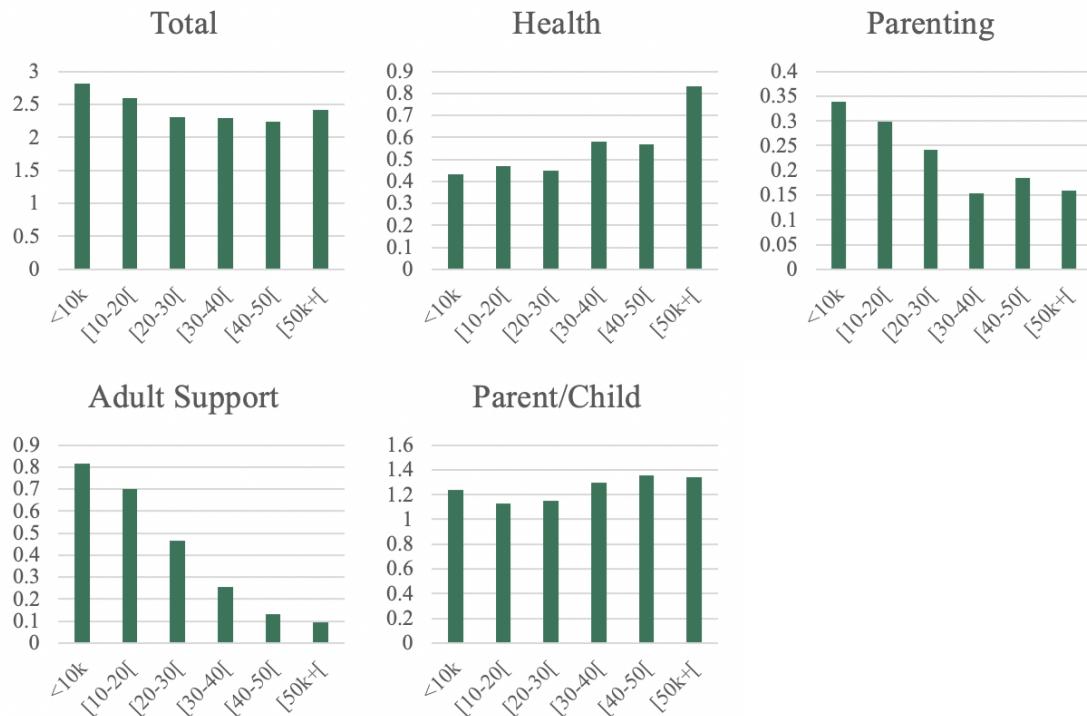


Table A.8: Effect of an increase in Sure Start coverage on probability of hospitalisation for any cause, by gender

	(1) Age 1	(2) Age 2	(3) Age 3	(4) Age 4	(5) Age 5	(6) Age 6	(7) Age 7	(8) Age 8	(9) Age 9	(10) Age 10	(11) Age 11	(12) Age 12	(13) Age 13	(14) Age 14	(15) Age 15
SS Cov: Boys	0.0291*** (0.0081)+++	0.0102 (0.0066)	0.0034 (0.0058)	-0.0105 (0.0073)	-0.0138*** (0.0063)+	-0.0126** (0.0061)	-0.0053 (0.0054)	-0.0053 (0.0039)	-0.0062* (0.0033)	-0.0060* (0.0031)	-0.0092** (0.0041)++	-0.0153*** (0.0046)+++	-0.0158*** (0.0058)++	-0.0212*** (0.0053)+++	-0.0249*** (0.0065)+++
SS Cov: Girls	0.0221*** (0.0072)+++	0.0089 (0.0062)	0.0046 (0.0058)	-0.0010 (0.0067)	-0.0080 (0.0061)	-0.0064 (0.0059)	-0.0022 (0.0053)	0.0006 (0.0041)	-0.0026 (0.0032)	-0.0051 (0.0031)	-0.0077** (0.0038)	-0.0098*** (0.0041)++	-0.0004 (0.0050)	0.0030 (0.0043)	0.0009 (0.0067)
Diff p-value	0.016	0.616	0.588	0.000	0.000	0.024	0.000	0.003	0.466	0.311	0.010	0.000	0.000	0.000	
Effect size diff p-value	0.798	0.592	0.384	0.004	0.253	0.106	0.247	0.003	0.062	0.717	0.746	0.184	0.000	0.000	
Baseline mean:															
Boys	0.2863 0.2241	0.2348 0.1739	0.2099 0.1482	0.1982 0.1392	0.1871 0.1375	0.1652 0.1225	0.1419 0.1101	0.1302 0.1018	0.1255 0.0995	0.1223 0.0933	0.1220 0.0959	0.1300 0.1044	0.1283 0.1174	0.1292 0.1331	0.1320 0.1499
Girls															
N	2822176	3084704	3347232	3609760	3675392	3675392	3675392	3675392	3675392	3675392	3478496	3215968	2953440	2690912	2428384
Earliest cohort	apr.96 des.06	apr.95 des.06	apr.94 des.06	apr.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 mar.05	jan.93 mar.05	jan.93 mar.04	jan.93 mar.03	jan.93 mar.02
Latest cohort															

Note: See notes to [Table 3](#). Each regression interacts Sure Start coverage with indicators for whether the cell contains boys or girls (coverage on its own is not included in this model.) ‘Difference p-value’ tests the equality of the coefficients for coverage interacted with boys and with girls. ‘Effect size difference p-value’ tests the equality of the effect size (coefficients weighted by subgroup baseline mean) for coverage interacted with boys and with girls. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively; +, ++ and + + + indicate significance at the 10%, 5% and 1% level, respectively, after adjusting inference following the procedure in algorithms 4.1 and 4.2 of [Romano and Wolf \(2005\)](#).

Table A.9: Effect of an increase in Sure Start coverage on probability of hospitalisation for any cause, by neighborhood deprivation

	(1) Age 1	(2) Age 2	(3) Age 3	(4) Age 4	(5) Age 5	(6) Age 6	(7) Age 7	(8) Age 8	(9) Age 9	(10) Age 10	(11) Age 11	(12) Age 12	(13) Age 13	(14) Age 14	(15) Age 15
Cov: Poorest 30%	0.0286*** (0.0093)++	0.0113 (0.0079)	0.0078 (0.0070)	-0.0031 (0.0081)	-0.0086 (0.0071)	-0.0091 (0.0066)	-0.0027 (0.0059)	-0.0022 (0.0043)	-0.0061* (0.0036)	-0.0073** (0.0035)	-0.0102** (0.0041)++	-0.0142*** (0.0047)+++	-0.0097* (0.0047)	-0.0181** (0.0049)	-0.0181*** (0.0049)
Cov: Middle 40%	0.0236*** (0.0068)++	0.0079 (0.0054)	-0.0018 (0.0046)	-0.0099* (0.0057)+	-0.0142*** (0.0051)++	-0.0102* (0.0053)	-0.0055 (0.0048)	-0.0027 (0.0038)	-0.0021 (0.0029)	-0.0032 (0.0029)	-0.0055 (0.0038)	-0.0097** (0.0039)++	-0.0058 (0.0050)	-0.0102* (0.0052)	-0.0024 (0.0055)
Cov: Richest 30%	0.0115 (0.0076)	0.0013 (0.0057)	-0.0013 (0.0054)	-0.0060 (0.0062)	-0.0120** (0.0057)	-0.0073 (0.0059)	-0.0022 (0.0056)	0.0001 (0.0045)	-0.0007 (0.0036)	-0.0004 (0.0033)	-0.0011 (0.0040)	-0.0021 (0.0049)	0.0013 (0.0059)	-0.0030 (0.0070)	0.0016 (0.0080)
Diff p-value:															
Poor vs. Middle	0.459	0.561	0.054	0.120	0.125	0.695	0.311	0.855	0.080	0.069	0.063	0.148	0.285	0.813	0.015
Poor vs Rich	0.054	0.175	0.135	0.604	0.427	0.630	0.872	0.433	0.046	0.012	0.005	0.002	0.019	0.362	0.011
Effect size diff p-value:															
Poor vs. Middle	0.499	0.982	0.048	0.011	0.001	0.090	0.177	0.625	0.194	0.240	0.274	0.577	0.480	0.566	0.037
Poor vs Rich	0.412	0.326	0.208	0.333	0.045	0.601	0.885	0.603	0.175	0.061	0.027	0.016	0.039	0.507	0.033
Baseline mean:															
Poorest 30%	0.3355	0.2708	0.2361	0.2233	0.2138	0.1874	0.1605	0.1472	0.1409	0.1346	0.1304	0.1394	0.1409	0.1499	0.1647
Middle 40%	0.2341	0.1866	0.1645	0.1541	0.1500	0.1333	0.1175	0.1085	0.1051	0.1003	0.1017	0.1098	0.1172	0.1253	0.1338
Richest 30%	0.2027	0.1613	0.1411	0.1332	0.1269	0.1141	0.1027	0.0946	0.0938	0.0908	0.0970	0.1046	0.1123	0.1200	0.1267
N	2822176	3084704	3347232	3609760	3675392	3675392	3675392	3675392	3675392	3675392	3478496	3215968	2953440	269912	2428384
Earliest cohort	apr.96 des.06	apr.95 des.06	apr.94 des.06	apr.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 des.06	jan.93 mar.06	jan.93 mar.05	jan.93 mar.04	jan.93 mar.03	jan.93 mar.02

Note: See notes to Table 3. Each regression interacts Sure Start coverage with indicators for whether the LSOA is in the poorest 30%, the richest 30%, or in between (coverage on its own is not included in this model.) Indicators for these different groups are not explicitly included in this model since they are time-invariant and so absorbed by the LOSA fixed effects. "p-value: Poor vs. Middle" tests the equality of the coefficients for coverage interacted with the indicators for being in the poorest 30% or the middle. 'p-value: Poor vs. Rich' does the same, testing the equality of the coefficients relating to the poorest and richest 30%. 'Effect size p-value' does the same, but for the effect sizes (coefficients weighted by subgroup baseline mean). *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively; +, ++ and + + + indicate significance at the 10%, 5% and 1% level, respectively, after adjusting inference following the procedure in algorithms 4.1 and 4.2 of Romano and Wolf (2005).

B Data sources for local authority characteristics

This appendix provides further detail on the sources, years of measurement and geographic levels of the local characteristics used in our quantitative analysis of the roll-out of Sure Start in section 5.1.1

As [Table B.1](#) makes clear, for most characteristics we have data covering the entire period between 1999 and 2018 (the period covered by our roll-out analysis in section 5.1.1). A major exception to this is the share of primary school pupils with English as an additional language (where data are not available between 2000 and 2003). In this case, we have imputed the data from these missing years with a constant and included a ‘missing’ dummy to avoid dropping these observations.

In addition, many of the data series have casewise missingness, where data are unavailable for some area–year combinations (but not more generally for the entire year or for the same area in every year). We use linear interpolation to reduce missingness in these data by imputing the missing data as an average of the non-missing observations in the same area in the year before and after. We apply this procedure in cases where up to five years of data are missing. Within the 323 local authority districts that we consider in the main impact analysis (dropping the City of London, Isles of Scilly and West Somerset, which were all strong outliers in Sure Start coverage), no casewise missing data remain after this procedure.

Table B.1: Covariates used in the rollout analysis

Category	Variable	Source	Years	Geography
Deprivation	Percentile of rank distribution of Index of Local Deprivation	Department of Environment, Trade, and the Regions[1]	1998	LAD
Health Indicators	Under-18 conception rate (conceptions/1,000 women aged 15-17)	Child and Maternal Health Intelligence Network[2]	1998-2018	LAD
	Proportion of births below 2.5kg	ONS Vital Statistics[3]	1991-2018 (interpolated in 2008 and 2009)	LAD
Potential Demand for services	Total period fertility rate	ONS Vital Statistics[4]	1990-2018	LAD
	Density	ONS Population Density[5]	1990-2018	LAD
	% of primary school pupils with English as an Additional Language	National Association for Language Development in the Curriculum (NALDIC)	1999; 2004-2018	County
	Children Looked After per thousand under 1	Department for Education	1992-2018	County
	Children Looked After per thousand 1 to 4	Department for Education	1992-2018	County
Labour Market	Rate of Jobseekers Allowance receipt	Jobseekers Allowance[7]	1992-2018	LAD
Pre-Existing Services	Number of GPs per 1,000 population	Constructed with HSCIC data[10]	1990-2018	LAD
	Number of JobcentrePlus per 1,000 population	Department for Work and Pensions	2001-2018	LAD
	Free entitlement take-up rate among 3 and 4-year-olds	Department for Education Statistical Returns	1997-2018	County

Notes: [1] Downloaded 20 Nov. 2015, <http://www.legco.gov.hk/yr99-00/english/bc/bc09/papers/1471e01.pdf>. [2] Downloaded 02 Nov. 2015, <http://atlas.chimat.org.uk/IAS/dataviews/view?viewId=96>. [3] Obtained 24 Nov. 2015 from the ONS Vital Statistics Outputs Branch, with help from Laura Todd. [4] Obtained 24 Nov. 2015 from the ONS Vital Statistics Outputs Branch, with help from Laura Todd. [5] Downloaded 18 January 2016 from ONS. [6] Downloaded 02 Dec. 2015 from NOMIS. [7] Downloaded 16 Dec. 2015 from NOMIS. [8] Deflated to constant 2015 pounds using the Consumer Price Index, downloaded from ONS Consumer Price Indices – Tables, table 1.1, series CPI All Items Index (estimated pre-97, 2005=100) on 27 January 2016. <http://www.ons.gov.uk/ons/datasets-and-tables/data-selector.html?dataset=mm23>. [9] Downloaded 15 December 2015 from NOMIS. [10] HSCIC, 'GPs, GP Practices, Nurses, and Pharmacies', downloaded 26 November 2015.

C Evidence on the relationship between behaviour and hospitalisation

In section 6, we show that Sure Start substantially reduces hospitalisations for accidents and injuries between ages 1 and 11. The impacts at younger ages may be driven by information and support in reducing risk in the home environment; indeed, we find that poisonings fall up to age 3. However, these direct informational effects are not a plausible mechanism for the longer-term falls in external hospitalisations that we observe. In this appendix, we present evidence from the Millennium Cohort Study (MCS) on the correlates of parent-reported injuries, highlighting that child behaviour - and particularly externalising behaviour - is strongly associated with injuries through middle childhood and early adolescence.

We use data from three waves of the MCS: wave 3 (age 5), wave 4 (age 7) and wave 5 (age 11).¹ At each wave, parents report injuries sustained by their child since the last wave (so ‘age 5’ results consider hospitalisations between ages 4 and 5, ‘age 7’ results for ages 6 and 7, and ‘age 11’ results for ages 8–11). We use as an outcome whether the parent reports any injury since the previous wave.²

The richness of the MCS data allows us to consider the link between child behaviour and injuries while controlling for a wide range of other potential correlates. These include child demographics (sex, ethnicity); maternal demographics (age at child’s birth, education); economic circumstances (maternal employment, household net earnings); and the home learning environment.³ In our specification with covariates, we also control for fixed effects for the child’s region of residence at the time of interview⁴ and the season of the interview. All regressions control for fixed effects of the child’s age in months at the time of interview.

We have two measures of child behaviour, both reported by the mother through the widely

¹The MCS data are taken from a single cohort born in 2000–01 and so will not necessarily be representative of all the cohorts in our impact analysis.

²The associations documented here are similar when we consider the number of injuries sustained since the previous wave. We focus on the ‘any injury’ indicator since it is more analogous to the outcomes in our main results.

³We construct a standardised measure of the home learning environment using factor analysis on a series of parental time inputs (for example, how often the parents read to the child, visit the library, or play games with the child).

⁴Since regional data is not available in the public-access version of MCS at wave 4 (age 7), we use the child’s wave 3 (age 5) region of residence instead.

used Strengths and Difficulties Questionnaire (SDQ). The ‘externalising behaviour’ score comes from the SDQ subscales on hyperactivity and conduct disorders. The ‘internalising behaviour’ score comes from the SDQ subscales for emotional problems and peer problems. Both indices are scored out of 20, with a higher score indicating more problems in that domain of behaviour.

Table C.1 presents the associations between behaviour and whether the child has sustained an injury since the previous wave. Columns 1, 3 and 5 show a significant relationship between externalising behaviour problems and injuries at ages 5, 7 and 11. An additional point on the externalising scale (out of 20) is associated with roughly a roughly 1-percentage point increase in the probability that a child has sustained an injury since the previous wave. By contrast, there is little association between internalising behaviour and injuries at any age.

Columns 2, 4 and 6 show that these associations are robust to the inclusion of a wide range of additional controls. While these results should not be interpreted as causal, they do provide suggestive evidence of a relationship between externalising behaviour and injuries that cannot be explained by the child’s demographics or family circumstances. This supports the hypothesis that a Sure Start-induced change in child behaviour is a plausible mechanism for the reduction in injury-related hospitalisations through middle childhood and early adolescence. This is also in line with findings from the ECCE project, which identified a reduction in externalising behaviour over time as one of the main benefits of using Sure Start services ([Sammons, Goff and Smith, 2015](#)).

Table C.1: Association between child behavioural problems and any parent-reported injury

	(1)	(2)	(3)	(4)	(5)	(6)
	Age 5		Age 7		Age 11	
Externalising behaviour	0.009*** (0.002)	0.006*** (0.002)	0.009*** (0.002)	0.007*** (0.002)	0.011*** (0.002)	0.008*** (0.002)
Internalising behaviour	0.001 (0.002)	0.002 (0.002)	-0.001 (0.002)	0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)
Female		-0.043*** (0.011)		-0.033*** (0.010)		-0.032*** (0.012)
Ethnicity: Mixed		-0.052* (0.029)		-0.038 (0.028)		-0.055* (0.031)
Ethnicity: Indian		-0.043 (0.028)		-0.056** (0.027)		-0.180*** (0.031)
Ethnicity: Pakistani or Bangladeshi		-0.088*** (0.021)		-0.095*** (0.020)		-0.179*** (0.023)
Ethnicity: Black		-0.075** (0.030)		-0.043 (0.029)		-0.147*** (0.032)
Ethnicity: Other		-0.068* (0.040)		-0.054 (0.038)		-0.203*** (0.043)
Mother's age at birth		-0.001 (0.001)		0.000 (0.001)		-0.000 (0.001)
Mother cohabiting		-0.035** (0.015)		-0.012 (0.014)		-0.024 (0.015)
Mother's education: A level		0.010 (0.017)		-0.002 (0.016)		-0.004 (0.018)
Mother's education: GCSE or below		0.017 (0.013)		0.016 (0.012)		-0.006 (0.014)
Mother's education: Missing		0.034 (0.025)		-0.003 (0.025)		-0.043 (0.030)
Mother's work status: Part-time		0.005 (0.013)		-0.009 (0.013)		-0.018 (0.015)
Mother's work status: Full-time		0.001 (0.014)		0.021 (0.013)		-0.015 (0.016)
Mother's work status: Unknown		-0.109* (0.061)		0.017 (0.052)		-0.055 (0.044)
Household net earnings (?)		0.000 (0.000)		-0.000 (0.000)		-0.000 (0.000)
Home learning environment		0.011* (0.006)		0.012** (0.005)		0.018*** (0.006)
Constant	0.219*** (0.009)	0.320*** (0.044)	0.190*** (0.008)	0.246*** (0.042)	0.315*** (0.009)	0.469*** (0.047)
Observations	6,971	6,960	6,974	6,963	6,947	6,924
R-squared	0.007	0.019	0.009	0.020	0.010	0.036
Mean	.26	.26	.228	.228	.358	.358
Age in months FE?	Yes	Yes	Yes	Yes	Yes	Yes
Region FE?		Yes		Yes		Yes
Interview quarter FE?		Yes		Yes		Yes

Standard errors in parentheses

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

Note: *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively. The outcome is an indicator for whether the parent reports that the child has sustained an injury since the last wave (i.e. from ages 3-5 for age 5 results; from ages 6-7 for age 7 results; and from ages 8-11 for age 11 results).

D Estimation of Sure Start effects on maternal employment

In addition to their focus on children's health and development, Sure Start centres also brought together existing services to support parental employment. Children's Centres were required to develop links with JobcentrePlus, an existing network of government-run agencies to support the unemployed in finding work. Children's Centres were also required to signpost parents towards existing childcare programmes, most notably the entitlement to a part-time free childcare place for 3- and 4-year-olds.⁵ Many Sure Start centres also offered information about further education and basic skills courses.

There is a large literature establishing that childcare subsidy programmes can affect parental employment in some contexts, but typically only for mothers whose youngest child is eligible for the programme (e.g. [Gelbach \(2002\)](#); [Cascio \(2009\)](#); [Brewer et al. \(2020\)](#)). While these parental employment outcomes are important in their own right, an increase in parental employment may also impact on children's development through higher family income and/or less parental time with children. To investigate the likely importance of this channel, we use the UK's Labour Force Survey (LFS) to analyse how access to Sure Start affected maternal employment.

Data and outcomes The LFS is collected in a staggered five-quarter rolling panel, with households entering the survey at different points in the year and then remaining in the sample for five consecutive quarters. We use a secure access version of the LFS that contains information both on the household's local authority of residence and on the precise birth date of all household members. To mirror our hospitalisation analysis, we focus on mothers whose children were all born between 1993 and 2006. To avoid mothers of newborn children (who most often take several months of maternity leave), we further restrict the sample to mothers who did not give birth during the period that they were in the LFS sample.

⁵The free entitlement was first introduced in 1997, offering a free childcare place to 4-year-olds for 12.5 hours per week, 33 weeks of the year. The programme was extended to cover 3-year-olds in April 2004, and the generosity of the system was increased in a series of reforms: by September 2010 it covered a 15-hour place for 38 weeks of the year.

As our primary outcome, we focus on an indicator for whether a mother is in paid work at the time she is surveyed by the LFS. As secondary outcomes, we consider whether mothers work part-time (fewer than 30 hours a week) or full-time, and whether they are in full-time education. Since mothers are observed up to five times in the LFS, each mother can be included multiple times in our model.

Sure Start treatment Since existing evidence suggests that the strongest effects should be found among mothers whose youngest child is eligible for support, we focus on the treatment a mother experiences in respect of her youngest child. Specifically, we use the same measure of Sure Start coverage as in our hospitalisation analysis (centres per thousand children aged 0-4 in the local authority, averaged over the child's first 60 months of life⁶). We assign this measure of Sure Start coverage to mothers based on the year and month of birth of their youngest child and their local authority of residence when they are first observed in the LFS.

Specification To evaluate the impact of access to Sure Start on maternal employment, we estimate [Equation 2](#) by OLS:

$$y_{iwdmqt}^a = \alpha + \delta^a SS_{dmt} + \pi_{wd} + \lambda_q + \gamma_{iq}^{am} + \phi^{a,k} g_{iq}^k * Ki\beta^a X_i + \epsilon_{wdmt}^a, a = 0, \dots, 15 \quad (2)$$

where y_{iwdmqt}^a is the outcome variable, an indicator for whether a mother i is in work. We estimate the model separately for mothers whose youngest child is a years old, for each age from 0 to 15. SS_{dmt} is the average Sure Start coverage of the mother's youngest child, based on when they were born (year t and month m) and where the family resides when they enter the LFS (ward w of local authority d). We include quarter-year fixed effects q to control for contemporaneous labour market conditions. We control flexibly for the ages of children in the household: γ_{iq}^{am} is a set of fixed effects for the youngest child's age in months at the time mother i is observed in quarter-year q . We also control for the presence and ages of up to four older children k through a continuous

⁶Where a child is less than five years old, we average coverage only over the months in which they have actually been alive.

measure of the older child's age in years g_{iq}^k interacted with an indicator K_i for whether there is such a child in the household.

Unlike our main hospitalisation regressions, [Equation 2](#) is run at the individual level. This means we are able to control for a range of individual characteristics X_i . We focus on characteristics that themselves could not have been affected by Sure Start exposure, namely mothers' ethnicity and age; in alternate specifications we allow for a wider range of controls (education and partnership status).

This specification mirrors our main hospitalisation specification ([Equation 1](#)). However, because [Equation 2](#) is run on individual-level survey data, we cannot include LSOA-level fixed effects (since there are not sufficient observations in each LSOA). We instead control for around 9,000 ward fixed effects (π_{ld}). Because we are running this analysis at the individual rather than neighbourhood cell level, we are able to use a more precise (monthly rather than quarterly) measure of Sure Start treatment, and to control for the youngest child's age in months rather than quarters.

D.1 Results: Maternal employment

We first consider the impact that Sure Start had on the probability of a mother being in work. These results are presented in [Figure D.1](#), which reports the estimates from 15 separate regressions, based on the age of the mother's youngest child. To account for the different baseline probabilities of employment at different ages, [Figure D.1](#) then rescales each of these coefficients by the baseline employment rate of women whose youngest child was that age in 1996.

[Figure D.1](#) shows no clear pattern in Sure Start's impacts on maternal employment. While there are statistically significant positive impacts at ages 1, 6 and 15 (and a significant negative effect at age 7), these come in the context of no clear overall pattern of results across the age profile. We present the full set of results in Column 2 of Tables [D.1](#) to [D.3](#).⁷

These tables also provide additional context for these results by showing a number of alternate

⁷We conduct similar analysis for subgroups of mothers: single mothers, partnered mothers, those with low education, and those with high education (high school and above). We find no consistent patterns of impacts among any of these subgroups. Results available on request.

specifications. For information, Column 1 presents the raw correlation between Sure Start access and maternal employment. Unsurprisingly, mothers with greater access to Sure Start - whose children are on average older - tend to have higher rates of employment.⁸

In Column 2 we control for ward fixed effects and for the set of basic controls shown in [Equation 2](#). In Columns 3, 4 and 5 we present three robustness checks. The first of these, in Column 3, allows for a local authority-specific linear time trend, estimated based on pre-treatment data and extrapolated to the post-Sure Start period. The inclusion of these estimated trends has very little impact on our results. In Column 4 we additionally control for characteristics of the mother that were potentially influenced by Sure Start exposure (education and partnership status); characteristics of the local labour market at the time of data collection (male and female median weekly full-time earnings and the local unemployment benefit claiming rate); and a range of local characteristics that may have helped to determine Sure Start's rollout, measured at the birth of the youngest child.⁹ While this extended set of controls has some impact on our estimates, it largely does not change the overall conclusion that our results give a mixed picture of Sure Start's impact on maternal employment, with generally non-significant effects.

As a final robustness check, in Column 5 we estimate our main equation (Column 2) on the subgroup of mothers with only one child. This sample restriction allows us to examine maternal employment in the simplest case, without the possibility of unmeasured spillovers from older children's treatment. Our results become substantially less precise, but we find similar patterns in terms of the direction and statistical significance of effects, except at the oldest ages.

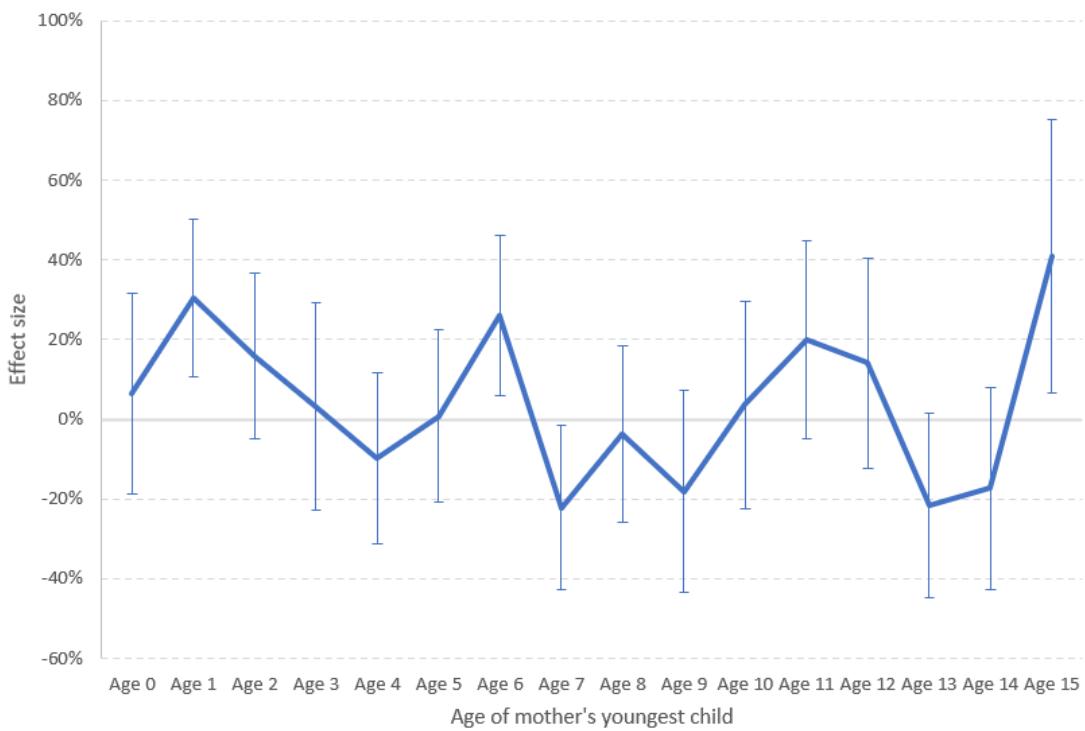
We also present the results of a specification check in Column 6 of Panel A. Here, we exploit the panel aspect of the LFS to control for mother fixed effects. This allows us to look within mothers at whether higher Sure Start coverage increases the probability that a mother is in work. Because Sure Start coverage only varies during a child's first five years of life (as the average coverage is updated to include additional months of treatment), this specification is only possible

⁸This is because Sure Start treatment is generally weakly increasing over a child's first five years, as new centres open in the child's local authority. Therefore, as children who are still age-eligible for Sure Start get older, their average level of access to Sure Start tends to increase.

⁹This is the same set of characteristics used in the robustness checks for our hospitalisation analysis.

where the youngest child is aged 4 or below (Panel A). This specification substantially decreases the precision of our estimates, but again we find statistically significant employment impacts only at age one. These effects are very large - implying that a mother gaining an additional centre per thousand children was nearly 30 percentage points more likely to be in work - but they once again come in a context of insignificant and inconsistent results at other ages, which make us reluctant to put substantial weight on this one result.

Figure D.1: Sure Start's effect on probability of mother being in work, rescaled by baseline probability



Note: The table shows coefficients from separate regressions for each outcome age. Coefficients are rescaled by the employment rate of mothers whose youngest child was born in 1996. Vertical bars indicate 90% confidence intervals.
Source: Authors' calculations using data from the UK Labour Force Survey and the Department for Education's data on the rollout of Sure Start.

Table D.1: Effect of an increase in Sure Start coverage on probability of mother being in work:
Youngest child aged 0-4

	(1)	(2)	(3)	(4)	(5)	(6)
Age 0	-0.014 (0.022)	0.032 (0.077)	0.022 (0.089)	0.005 (0.085)	0.033 (0.102)	-0.139 (0.130)
N	28,190	28,190	28,190	28,190	16,087	28,190
Baseline mean	0.5036	0.5036	0.5036	0.5036	0.5349	0.5036
Age 1	-0.044** (0.020)	0.165** (0.065)	0.150** (0.073)	0.147** (0.074)	0.280*** (0.084)	0.285** (0.128)
N	45,595	45,595	45,595	45,595	25,147	45,595
Baseline mean	0.5429	0.5429	0.5429	0.5429	0.5883	0.5429
Age 2	-0.063*** (0.021)	0.087 (0.069)	0.05 (0.068)	0.091 (0.068)	0.007 (0.119)	0.105 (0.142)
N	37,605	37,605	37,605	37,605	19,065	37,605
Baseline mean	0.5449	0.5449	0.5449	0.5449	0.5825	0.5449
Age 3	-0.063*** (0.020)	0.018 (0.091)	0.02 (0.090)	0.028 (0.095)	-0.028 (0.149)	-0.055 (0.175)
N	31,162	31,162	31,162	31,162	14,282	31,162
Baseline mean	0.5774	0.5774	0.5774	0.5774	0.6178	0.5774
Age 4	-0.070*** (0.018)	-0.063 (0.083)	-0.063 (0.083)	-0.046 (0.081)	-0.206 (0.158)	0.166 (0.186)
N	27,028	27,028	27,028	27,028	11,473	27,028
Baseline mean	0.6411	0.6411	0.6411	0.6411	0.6732	0.6411
Fixed effects		Ward	Ward	Ward	Ward	Mother
Trends?			Estimated	Estimated	Estimated	
Basic Controls?		Y	Y	Y	Y	
Extended Controls?						Y
Sample restrictions?					Only children	

Note: *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively. Standard errors are clustered at the LA level.

Table D.2: Effect of an increase in Sure Start coverage on probability of mother being in work:
Youngest child aged 5-10

	(1)	(2)	(3)	(4)	(5)
Age 5	-0.092*** (0.016)	0.005 (0.092)	0.009 (0.090)	-0.047 (0.089)	-0.159 (0.203)
N	24,247	24,247	24,247	24,247	9742
Baseline mean	0.7013	0.7013	0.7013	0.7013	0.69
Age 6	-0.063*** (0.017)	0.183** (0.086)	0.179** (0.089)	0.221** (0.089)	-0.006 (0.204)
N	22,292	22,292	22,292	22,292	8727
Baseline mean	0.7039	0.7039	0.7039	0.7039	0.7028
Age 7	-0.034** (0.017)	-0.165* (0.093)	-0.161* (0.093)	-0.122 (0.091)	0.199 (0.228)
N	21,148	21,148	21,148	21,148	8247
Baseline mean	0.7453	0.7453	0.7453	0.7453	0.7045
Age 8	-0.014 (0.017)	-0.028 (0.101)	-0.024 (0.101)	-0.134 (0.111)	0.247 (0.324)
N	20,610	20,610	20,610	20,610	7956
Baseline mean	0.7487	0.7487	0.7487	0.7487	0.7265
Age 9	-0.022 (0.018)	-0.137 (0.116)	-0.118 (0.119)	-0.185 (0.136)	-0.377 (0.259)
N	19,834	19,834	19,834	19,834	7538
Baseline mean	0.7571	0.7571	0.7571	0.7571	0.738
Age 10	0.004 (0.017)	0.028 (0.123)	0.000 (0.123)	0.059 (0.127)	0.156 (0.271)
N	19,116	19,116	19,116	19,116	7228
Baseline mean	0.7795	0.7795	0.7795	0.7795	0.7906
Fixed effects		Ward	Ward	Ward	Ward
Trends?			Estimated	Estimated	Estimated
Basic Controls?		Y	Y	Y	Y
Extended Controls?					
Sample restrictions?					Only children

Note: *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively. Standard errors are clustered at the LA level.

Table D.3: Effect of an increase in Sure Start coverage on probability of mother being in work:
Youngest child aged 11-15

	(1)	(2)	(3)	(4)	(5)
Age 11	0.012 (0.018)	0.157 (0.119)	0.152 (0.120)	0.178 (0.139)	0.113 (0.297)
N	18,784	18,784	18,784	18,784	7357
Baseline mean	0.7886	0.7886	0.7886	0.7886	0.7794
Age 12	-0.007 (0.018)	0.113 (0.128)	0.112 (0.126)	0.008 (0.122)	-0.01 (0.290)
N	18,809	18,809	18,809	18,809	7651
Baseline mean	0.8007	0.8007	0.8007	0.8007	0.8316
Age 13	0.014 (0.017)	-0.174 (0.113)	-0.169 (0.111)	-0.028 (0.112)	-0.582* (0.311)
N	17,854	17,854	17,854	17,854	7650
Baseline mean	0.806	0.806	0.806	0.806	0.7816
Age 14	-0.026 (0.023)	-0.14 (0.124)	-0.159 (0.121)	-0.072 (0.124)	-0.657** (0.302)
N	16,385	16,385	16,385	16,385	7829
Baseline mean	0.8053	0.8053	0.8053	0.8053	0.769
Age 15	-0.014 (0.028)	0.324* (0.165)	0.348** (0.164)	0.459*** (0.177)	0.213 (0.265)
N	14,835	14,835	14,835	14,835	8064
Baseline mean	0.7932	0.7932	0.7932	0.7932	0.7613
Fixed effects		Ward	Ward	Ward	Ward
Trends?			Estimated	Estimated	Estimated
Basic Controls?		Y	Y	Y	Y
Extended Controls?				Y	
Sample restrictions?					Only children

Note: *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively. Standard errors are clustered at the LA level.

E Cost-Benefit Analysis of Sure Start

This section reports the details of a simple cost–benefit calculation we performed to assess whether Sure Start is good value for the government money. We do so by combining official data on government expenditures on Sure Start with the estimates obtained in the previous sections, and also results from the best published literature. We compute the averted costs in terms of hospitalisations attributable to providing access to Sure Start to 1,000 more children (i.e. from opening one more centre at the peak coverage level).

We are not the first to try to quantify the monetary benefits of Sure Start. [Meadows \(2011\)](#) calculated that SSLPs cost around £1,300 per eligible child per year at 2009–10 prices (or £4,860 per eligible child over the period from birth up to age 4); and that by the time children had reached the age of 5, SSLPs had already delivered economic benefits between £279 and £557 per eligible child (coming from reduction in workless households), which is 6–12% of the total cost of the programme. The authors concluded that this is a large impact, given the early stage at which it is measured, but that there was insufficient information to reliably predict longer-term economic impacts.

[Gaheer and Paull \(2016\)](#) collected very detailed cost data on different types of services delivered in 24 of the SSCCs that participated in the ECCE: baby health, child play, parent support, specialist child support, specialist family/parent support, childcare, finance and work support, and training and education. The average cost per user per hour (the value of resources used to deliver one hour of a service to a child) ranged from £6 for childcare to £55 for finance and work support, while the mean cost per family using the service (which accounts for the hours of usage) ranged from £958 for parent support to £8,454 for childcare. The authors then combined estimates on the associations between the use of different types of SSCC services and improved family outcomes with existing evidence from the literature on long-term effects. They found that some SSCC services provide positive value for money, i.e. the monetary valuation of improved outcomes exceeds the cost of delivery.

In our case, we have decided to compute in an alternative way the cost of Sure Start. Our choice is informed by different factors. First, we have not collected detailed costs data as was done in the NESS and ECCE evaluations. Second, given that we evaluate the effects of Sure Start using the whole period it was in place, it would be difficult to compute a measure of costs valid for both SSLPs and SSCCs. Third, our measure of costs needs to be consistent with the methods we use in the estimation of the impacts, which studies the effects of access to, rather than usage of, Sure Start. For these reasons, we compute the cost of Sure Start per eligible child, by dividing the overall government expenditures on Sure Start by the number of eligible children, i.e. the number of children aged 0–4 in the local authorities in which Sure Start was in place in that particular year. This is consistent with the aim of the government (especially at programme maturity) to provide Sure Start to every child, and the fact that Sure Start was area-based, rather than means-tested. The cost per child computed in this way amounts to £415.9 per eligible child, on average.

Weighed against Sure Start’s cost to taxpayers, we can consider the financial benefits of the hospitalisations that Sure Start averted. In doing this calculation, we only want to consider impacts that are statistically significant (i.e. that we can be confident are not just due to chance), for the following conditions: injuries and poisoning (a subset of external), respiratory, parasitic/intestinal, and mental health. We consider three types of costs:

- Averted direct healthcare costs. We use specific NHS resource use costs for each of these conditions, taking the average cost among the different categories for non-elective long and short stay.
- Averted indirect costs, over the same ages as the healthcare costs, such as costs to the family and to society (e.g. lost income and value of work time lost).
- Averted long-term costs, for those cases that would incur sustained costs over the life cycle (such as those deriving from traumatic brain injury or attributable to child maltreatment, or for mental health conditions).

The main results of our cost–benefit calculation are reported in [Table E.1](#). All costs are in

2018–19 prices, and discounted using a 3.5% discount rate as recommended by the National Institute for Health and Care Excellence (NICE). The total financial benefit from averted costs, obtained by adding together the direct healthcare costs, indirect costs throughout childhood and long-term costs, amounts to around £330 million. Of this, around £3.9 million is attributed to direct cost savings to the NHS from fewer hospitalisations at ages 1–15. As expected, the bulk of the total averted cost is attributable to the lifetime costs of traumatic brain injury and mental health conditions. Set against this is the estimated cost of providing an additional Sure Start centre per thousand children to a representative cohort, which we calculate at £1,055 million. On this basis, then, we find that the financial benefits from reducing hospitalisations offset approximately 31% of the cost of Sure Start provision (with direct savings from the reduction in hospitalisations at ages 1–15 amounting to 0.37% of spending on Sure Start). Of course, the benefits of Sure Start may extend to other domains beyond health since the programme was designed to promote child development in a holistic way and through a variety of services. To accurately measure the full benefits of Sure Start against its cost, it will therefore be crucial to look at additional outcomes that the programme could have improved. This is precisely what we will do in a new project funded by the Nuffield Foundation looking at the impacts of Sure Start on children’s attainment, use of social care, and offending behaviour. As part of the project, we will update the cost–benefit analysis of the programme.

Table E.1: Estimated costs and benefits of Sure Start for one cohort of children (2018–19 prices)

Total programme expenditures	£1,055 million
Total costs from averted hospitalisations	£330 million
<i>Of which:</i>	
Direct healthcare costs (1.2%)	£3.9 million
Indirect costs (1.3%)	£4.3 million
Long-term costs (97%)	£322 million