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Impact of free availability of public childcare on labour supply and child development in Brazil

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Summary

In this report, we examine the impacts of having access to freely available full-time childcare on child development, the labour supply of household members and home environments. We use data from the city of Rio de Janeiro, Brazil, primarily from households residing in slums.

Rio de Janeiro's public day care programme is an integrated early childhood development programme for children aged 0–3 living in low-income neighbourhoods. The programme consists of a variety of centre-based interventions, including full-time day care, health services, food and the provision of instructional toys and material for children.

It is expected that access to these well-equipped and properly managed day care centres, by providing a nurturing and stimulating environment for disadvantaged children, will boost human capital accumulation by the poor. Because parents are encouraged to participate in the lives of their children in the centre, and even get parenting information from the centre's staff, we also could expect a change in parenting behaviours. In addition, it is expected that mothers and other household members caring for the children are able to seek employment and increase their earnings, thereby improving the well-being of their households. This would be another mechanism through which access to childcare could lead to better child development.

This study takes advantage of a lottery used by the municipal government of Rio de Janeiro in 2007 to identify the causal relationship between access to day care, child development and maternal labour market outcomes. Every year, the government of Rio offers approximately 10,000 new slots for centre-based day care for children aged 0–3. In 2007, as in previous years, demand for these slots far outstripped supply. More than 25,000 families applied for the 10,000 new slots. To ensure equality of opportunity, a lottery was used to assign the slots among all eligible applicants (approximately 24,000 out of the 25,000). New beneficiary children started to receive services in February 2008.

We collected a rich dataset that includes various child assessments and a very detailed household survey.

We find quite strong impacts of the attendance at public day care on the height and weight of children, several years after they left the crèches. In addition, we also find that having access to a day care centre produces strong and lasting impacts on household income, expenditure on consumer durables and on investments in children – in both time and goods.

Notably, there is an increase in the labour supply and income of grandparents (mostly grandmothers) residing in the same household as the child attending day care. Remarkably, these impacts are present even four and a half years after the initial randomisation, at a time when very few of the children in our sample still attend crèches.

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Abbreviations and acronyms

ASQ	Ages and Stages Questionnaire (ASQ-3 is the third edition of this questionnaire, which has various components)
BFA	BMI for age
BMI	Body mass index
CBQ	Child Behaviour Questionnaire, which has various components
CI	Confidence interval
HFA	Height for age
HTKS	Head-Toes-Knees-Shoulders assessment
ITT	Intention to treat
IV	Instrumental variables
PENCIL	Pencil Tapping Test
STROOP	Stroop Test, which has various components
TMCQ	A more age-appropriate version of the CBQ (used for sample C in this study)
TVIP	Peabody Picture Vocabulary Test
WFA	Weight for age
WISC	Wechsler Intelligence Scale for Children (WISC)
WJ-VIS	Woodcock-Johnson-Muñoz Visual Integration Test
WJ-MEM	Woodcock-Johnson-Muñoz Memory for Names Test (WJ-MEM1, WJ-MEM2 and WJ-MEM3 represent test parts of increasing difficulty)

1. Introduction

Children growing up in poverty face multiple barriers to their development. Early disadvantage frequently leads to disadvantage in adulthood. However, there is also strong evidence that high-quality early childhood interventions can have dramatic impacts in children's lives, with very high rates of return (for example, Carneiro and Heckman 2003).

Most of this evidence comes from programmes implemented at a very small scale, often involving little more than 100 children. A central question is whether large-scale early childhood interventions can produce large gains in the development of poor children.

There are several alternative early childhood programmes that could potentially be scaled up. One alternative, which is popular with many governments in middle-income (and upper-income) countries, is the public provision of formal childcare. This report analyses the impacts of large-scale provision of free centre-based childcare to poor families in the city of Rio de Janeiro on child development, maternal labour market outcomes and family environments.

Unfortunately, centre-based care is a very expensive way of providing early childhood services. It requires substantial infrastructure and well-trained staff. Therefore, it is essential to measure whether it has important impacts on child development.

An additional argument that governments make in favour of providing public centre-based care, especially full-day care, is that it allows mothers to take up employment (for example, Blau and Currie 2006). When available, full-day childcare (provided for free) is a highly demanded service.

This report analyses the impact of access to formal childcare on child development, and on a large range of maternal and household outcomes. Our data comes from Rio de Janeiro, where childcare centres are also known as crèches (we use the two expressions interchangeably throughout this report).

Although the supply of these services has been growing steadily in Rio de Janeiro, the demand for public childcare slots is still much larger than the available supply. As a result, the municipal government, which is responsible for providing and managing early childhood services, needs to allocate scarce childcare places among those families wishing to enrol their children in these centres.

Between the school years starting in January 2008 and January 2011, a lottery was used to determine which children in each centre's application lists would receive a spot in that centre. This allows us to evaluate the impact of childcare attendance on child development, maternal employment and home environments, by comparing children who won and who lost in this lottery. Because of randomisation, lottery winners and losers are identical on average. Starting in January 2012, enrolment in public childcare centres has become purely means-tested (the lottery was abandoned).

This report focuses on children applying for a place in a childcare centre late in 2007 (desiring to enrol in January 2008). In November 2007, the municipal government decided to use a lottery to select 10,000 children out of a pool of approximately 24,000

applicants for the 2008 enrolment period. Therefore, many eligible households who had applied were randomly excluded from the programme by being placed on a waiting list. A sample of 4,348 applicant children was drawn, of which 2,174 (50 per cent) were lottery winners. The remaining children in the sample came from those placed on the waiting list.

This sample was first surveyed between June and October 2008, 4–8 months after the lottery winners were first exposed to childcare. Interview materials were designed to measure their basic socio-economic indicators, to assess the validity of the randomisation and to estimate the impact of access to childcare on labour market outcomes for the main carers of the child participating in the lottery (the 'focal child'). In more than 75 per cent of cases, the carer was the mother of the child.

An analysis of this data by Barros *et al.* (2012) finds that, at least in the short run, access to free publicly provided childcare services leads to a very large increase in the use of childcare (from 51 to 94 per cent) and a considerable increase in the proportion of carers who are working (from 36 to 46 per cent). Their analysis finds no statistically significant impact on hours worked among those carers who were employed. The rise in mothers' employment is associated with an increase in household incomes of 16 per cent (from an average of R$569 to R$661 per month).[1]

This report greatly extends the earlier study of Barros *et al.* (2012), by using more recent surveys of participants in the 2008 lottery. It also considers several measures of family resources and home environments, especially child development. As we describe below, we have collected additional surveys of these children in 2012 and 2015, several years after lottery winners first had the opportunity to enrol in public childcare centres, thereby allowing us to measure the medium-term impacts of formal childcare attendance.

This is a very important aspect of our study. While it is incredibly useful to measure the short-term impacts of these interventions, it is essential to be able to go beyond this, since several early interventions are known to have strong short-term impacts that quickly fade. One important and very recent example comes from the (also randomised) Head Start Impact Study, which shows early impacts on a variety of measures of child development that essentially disappear by the time the child reaches the first grade of school (Office of Planning, Research and Evaluation 2012). At the time of our 2012 survey, less than 30 children (1–2 per cent) in the whole sample were still attending a crèche, while in 2015 there no children in our sample were still in childcare.

We start by documenting the fact that, several years after the original randomisation took place, about 89 per cent of lottery winners ended up enrolling in childcare. Among lottery losers, the percentage of children who ended up attending childcare is lower, albeit still quite high at 71 per cent. This means that the random offer of a spot in a childcare centre only increased the probability of enrolment by 19 percentage points. This difference in childcare attendance between lottery winners and losers is statistically different from zero, with an F-statistic above 80. We also analysed children's length of time in a childcare setting, and we estimate that winning a childcare place via the lottery led on average to one extra semester in childcare.

[1] US$1 is approximately R$4.

We then proceed to analyse measures of child development, namely tests of executive function, vocabulary memory, visual integration and anthropometric data alongside maternal reports of behavioural problems among the children. We find strong impacts of childcare attendance on height and weight, and suggestive impacts on other child assessments.

We also find that winning the lottery caused an increase in household income, as well as an increase in the labour supply of adults residing in the same house as the child. This is especially true when we compare the grandmothers (who live with the child) of children in the winners' and losers' groups. This result is particularly remarkable given that, at the time of our survey, almost all of the children had been out of childcare for several years. Finally, children who won the lottery live in households with more books and are more likely to be read to regularly than those who did not win the lottery.

2. Intervention, theory of change and research hypotheses

Rio de Janeiro's public day care programme is an integrated early childhood development programme for children aged 0–3 living in low-income neighbourhoods. The programme consists of a variety of centre-based interventions, including full-time day care, health services, food and the provision of instructional toys and material for children. As of January 2008, there were 244 public day care centres providing these services spread around most low-income neighbourhoods of the city. In addition, the programme foresees involvement by parents as a way of improving knowledge about good parenting practices.

The overall quality of these day care centres is probably not very high when compared with similar centres in developed countries. Although we do not have teacher–student ratios for Rio de Janeiro, we know that they average around 26 in day care centres in Brazil. We suspect that these figures are not much lower in Rio. Similarly, when we look at childcare centres in six major Brazilian municipalities that were observed using standard tools employed to evaluate childcare centres in the US, we see that more than 90 per cent of these centres have a rating below *good* (Evans and Kosec 2012). As a comparison, there is not one Early Head Start (EHS) centre in the EHS centre evaluation study (which is supposed to be representative of EHS centres in the US) with a rating below *good*.

It is expected that access to good-quality and properly managed day care centres will boost human capital accumulation by the poor, by providing a nurturing and stimulating environment for disadvantaged children. Because parents are encouraged to participate in the lives of their children in the Rio de Janeiro centres, and even receive parenting information from the centre's staff, we also could expect a change in parenting behaviours. In addition, it is expected that mothers and other household members caring for the children attending day care are able to seek employment and increase their earnings, thereby improving the well-being of their households. This is another mechanism through which access to childcare could lead to better child development.

It is quite possible that impacts on these outcomes, even labour market outcomes of household members, outlast the years in which the child is eligible for crèche attendance. The theory is that the free availability of crèches allows women in the

household not to interrupt their careers when childcare needs arise. The possibility of having an uninterrupted working career may be helpful in securing good-quality jobs in a sustained way.

3. Context

Brazil is a middle-income country with very high levels of inequality. Although the first decade of the twenty-first century saw a significant improvement in the incomes of the country's poor, perhaps driven by Brazil's new welfare programmes, this trend has stopped in recent years.

Preschool education in Brazil is under the administrative responsibility of the municipality. Different municipalities offer different services, from centre-based care to parenting programmes and home visits, for example.

The school starting age in Brazil is four.[2] However, compliance with this law is imperfect. Currently, just a little over 60 per cent of four and five year-olds attend any type of school. Childcare coverage at earlier ages is much lower. Only 20 per cent of children aged 0–3 are in formal childcare. Coverage is especially low for poor children (those in the lowest income quartile), barely reaching 10 per cent. However, in recent years, the expansion of public day care in Rio de Janeiro has managed to increase the childcare rates for poor children to the levels of children in rich households, although those with levels of income close to the median still have low access to public day care centres for their young children.

4. Timeline

Public day care centres have existed in Rio de Janeiro for a number of years, and they have been rapidly expanding over the past decade. Our study is focused on the cohort of children who were eligible to enrol in a childcare centre in 2008.

This study takes advantage of a lottery used by the municipal government of Rio de Janeiro in 2007 to identify the causal relationship between access to day care, child development and maternal labour market outcomes. Every year, the city's government offers approximately 10,000 new slots for centre-based day care for children aged 0–3. In 2007, as in previous years, demand for these slots far outstripped supply. More than 25,000 families applied for the 10,000 new slots. To ensure equality of opportunity, a lottery was used to assign the slots among all eligible applicants (approximately 24,000 out of the 25,000). New beneficiary children started to receive services in February 2008.

Between June and October 2008, a survey was carried out on a sample of 4,348 households. The sample was evenly distributed between families of the childcare lottery winners and losers. The survey is described in more detail below. However, of the 4,348 individuals in the original sample, only 3,776 were actually interviewed. The data was thoroughly analysed in Barros *et al.* (2012) and is not the focus of this report, although we refer to the main results of that study.

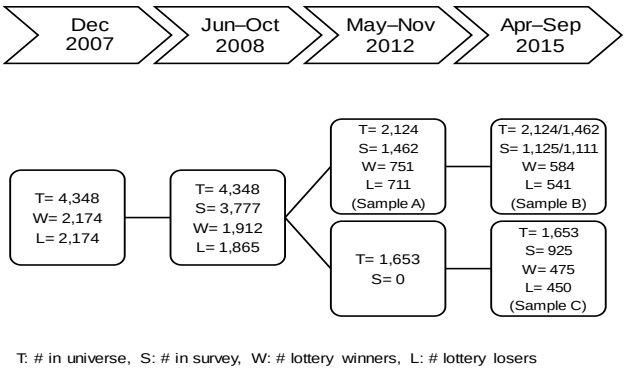
[2] The 59th Amendment to the Brazilian Constitution (from 2009) made schooling mandatory from the age of four. In 2013, this amendment was finally incorporated in the law regulating the provision of education in Brazil (Law 12796 of 4 April 2013).

In 2012, 2,124 of these 3,776 families were contacted for a repeat interview. The 3,776 families interviewed in 2008 were located in 10 different education districts in Rio de Janeiro. The 2,124 families approached for interview in 2012 corresponded to all families residing in six out of the 10 education districts in the original sample. All 3,776 families were scheduled to be interviewed in 2012, but logistical constraints delayed the survey for families in the remaining four education districts. Out of these 2,124 families, 1,462 were actually found.

In 2015, these families were surveyed again, together with the families residing in the four education districts not covered in the 2012 survey. At that point, 1,125 families were found among those interviewed in 2012, and 925 families were found in the remaining group (interviewed in 2008 but not in 2012), giving a total sample of 2,050.

Figure 1 displays our sampling. We discuss below in detail the potential influence of such high attrition on our estimates.

Figure 1: Timing of survey and sample sizes



T: # in universe, S: # in survey, W: # lottery winners, L: # lottery losers

5. Evaluation: design, methods and implementation

5.1 Evaluation design

Our research design is based on random assignment of applicants for childcare slots into treatment and control groups.[3] Random assignment is guaranteed by the lottery method described above, and in turn it means that children in the treatment and control groups are similar, at least on average.

Parents in Rio de Janeiro may only apply to one childcare centre of their choice. Within each centre, there are a given number of vacancies for each age group. In 2008, whenever there was excess demand for slots in a particular age group–crèche combination, a lottery took place to allocate slots to applicants.

Being a lottery winner guaranteed a slot in a public day care centre, but did not force the individual to actually enrol in the centre. Similarly, losing the lottery did not preclude a child from reapplying to the lottery, say in the following year. Therefore, the lottery outcome is a strong but not perfect predictor of day care attendance between the ages of 0 and 3. This means that we will present both intention to treat (ITT) and instrumental

[3] A team led by Ricardo Paes de Barros conducted the lottery. There was complete oversight of this procedure by members of our research team, ensuring that the allocation really was random.

variable (IV) estimates of the impacts of day care attendance on children and upon their household outcomes.

Since the lottery took place for each age group and day care centre, we need to include fixed effects for all combinations of day care centre and age group in the sample (although excluding such fixed effects from our analysis leads to similar results). We allow for correlation in the regression residuals within each day care centre, even after accounting for the fixed effects discussed above, in order to capture any other obstacles that may affect children participating in the same lottery. In other words, standard errors are clustered at the level of the crèche.

Therefore, our ITT estimates are based on the following regression equations, which are estimated by ordinary least squares regression, with standard errors clustered at the level of the day care centre:

$$Y_{igc} = \alpha + \beta L_{igc} + \delta_{gc} + \varepsilon_{igc} \ (1)$$

where Y_{igc} is an outcome of interest for individual *i*, who participated in the lottery for age group *g* in day care centre *c*, L_{igc} is an indicator variable that takes value 1 if individual *i* is a lottery winner and 0 otherwise, δ_{gc} is a set of fixed effects for each *g-c* pair, and ε_{igc} is an error term that is allowed to be correlated for all individuals applying for the lottery in each day care centre *c* (even if they were in different age groups), but which is independent across different day care centres (in order to capture potential spatial correlation in the residuals). β is the ITT parameter.

Our IV estimates are based on a slightly different regression:

$$Y_{igc} = \alpha + \gamma T_{igc} + \delta_{gc} + \varepsilon_{igc} \ (2)$$

where T_{igc} is an indicator variable taking value 1 if individual *i* ever attended a day care centre, and 0 otherwise. We also examine specifications where T_{igc} measures instead the number of semesters a child has ever spent in a childcare centre. This equation is estimated using a standard IV estimator, where L_{igc} is used as the instrumental variable for T_{igc}.

In addition, we consider an important extension of this framework. For a subsample of individuals, we have data for 2012 and 2015. When we pool all the data together, we estimate the following (ITT) specification:

$$Y_{igcw} = \alpha + \beta L_{igc} + \rho\left(L_{igc} * W_{igcw}\right) + \pi W_{igcw} + \delta_{gc} + \varepsilon_{igc} \ (3)$$

where *w* indexes survey wave (2012 or 2015), and W_{igcw} is an indicator taking value 1 if a given observation corresponds to the 2015 survey wave and 0 if it corresponds to the 2012 wave. In this specification, β measures the impacts of winning the lottery on 2012 outcomes (for the 2012 sample), while ρ measures the differential impact in 2015 outcomes.

5.2 Data

Between June and October 2008, a sample of 3,776 households were surveyed, drawn from a universe of 4,348 households. The sample was evenly distributed between families of lottery winners and losers. In addition to a variety of socio-economic

indicators, the survey gathered information on current and past labour market outcomes of mothers in the treatment and control groups. While most treatment children were already receiving services when the survey went to the field, recall data was also collected on pre-programme labour force participation to test the validity of the random assignment. This survey was analysed in detail by Barros *et al.* (2012), who found no significant departures from randomisation.

A subset of this sample, consisting of 2,124 children and their families, was contacted for a repeat interview between June and November 2012. Whereas the original 2008 sample came from 10 educational districts, the smaller sample in our study only corresponds to six of these districts. The remaining districts were surveyed between March and October 2015.

Of the 2,124 families contacted in 2012, only 1,462 were actually interviewed, resulting in an attrition rate of 30 per cent four and a half years after the randomisation. We call this sample A. In 2015 we attempted to resurvey all 1,462 families interviewed in 2012, but were able to find only 1,125, resulting in a further decline in our sample. We call this sample B. In addition, we attempted to contact an additional 1,555 families who were interviewed in 2008, but who were not contacted in 2012. Out of those, we managed to find 925. We call this sample C (see Figure 1).

These rates of attrition are substantial. We discuss below why it is very difficult to achieve much lower rates for a study such as ours. We also show that any correlation between attrition and treatment is small or non-existent. In addition, although there is selective attrition when we look at observable variables, it is not differentially selective between treatment and control groups. Therefore, we conclude that selective attrition is not likely to be an important concern in our study, since it does not differentially affect lottery winners and lottery losers. (In the Appendix, we present some additional estimates using interviewer information from the 2008 survey and a control function method to account for selective attrition, which suggest that selective attrition has no significant impact on our main estimates.)

During the 2012 and 2015 fieldwork, two interviewers simultaneously visited each participating family. One interviewer was in charge of administering the household questionnaire, while the other administered developmental tests to the focal child in the household.

The household survey includes 12 modules for sample A surveyed in 2012 and for sample C surveyed in 2015. The first two gathered basic demographic information about each household member. In case the child's main carer lived outside the household, information was collected for the carer as well. The following two modules concerned education and labour market variables for each household member. This is followed by modules on assets, food expenditure and housing conditions; perception of violence in the neighbourhood; school and childcare history of the focal child; home environments; depression of the primary carer; and allocation of each hour of the day across different activities (time diary). Finally, there are two modules where the interviewers recorded their own observations of the relationship between the carer and the focal child during the interview, and observations of the characteristics of the home.

The household survey for sample B, surveyed in 2015, has many similarities with the one just described. However, since we were resurveying the same households interviewed in 2012, and some of the data from the 2012 survey were already analysed, we decided to change a few modules. We deleted the modules on perception of violence and maternal depression and we added a module on child health. We also greatly expanded the modules on home environments, home expenditures and time use. We focused the time use module on the child, rather than on the respondent or the carer.

Our survey included multiple child assessments. We first describe the assessments in samples A and C. Two of them, the Ages and Stages Questionnaire third edition (ASQ-3; Squires and Bricker 2009) and the short form of the Child Behaviour Questionnaire (CBQ) (Rothbart *et al*. 2001) are largely based on maternal reports.

The ASQ is divided into five scales: communication (ASQ-COM), gross motor (ASQ-GRO), fine motor (ASQ-FIN), problem solving (ASQ-PRO) and socio-emotional (ASQ-SOC). Similarly, the CBQ also has five subscales that we analyse separately: attention focusing (CBQ-ATT), frustration (CBQ-FRU), soothability (CBQ-SOO), impulsivity (CBQ-IMP) and inhibitory control (CBQ-INH).

The ASQ was only used in 2012 since by 2015 the children were too old for it. In addition, in 2015 we also administered a more age-appropriate version of the CBQ to sample C, developed by the same authors as the CBQ: the TMCQ.

The remaining assessments were administered directly to the children. These include Head-Toes-Knees-Shoulders (HTKS; Ponitz *et al.*, 2008, 2009), Pencil Tapping Test (PENCIL; Diamond and Taylor 1996) and different versions of the Stroop Test (STROOP) (Stroop 1935), which are all executive function tests.

We also administered two batteries of the Woodcock-Johnson-Muñoz tests (Muñoz-Sandoval *et al.* 2005): Visual Integration (WJ-VIS) and Memory for Names (WJ-MEM). In addition, we applied the Peabody Picture Vocabulary Test (TVIP; Dunn *et al.* 1986) both to the focal child and to the mother (when she was present in the interview). Finally, we took weight and height measurements for every child.

Some of these instruments have two or three parts, of increasing difficulty. This is true of HTKS (HTKS1 and HTKS2), STROOP (STROOP1 and STROOP2) and WJ-MEM (WJ-MEM1, WJ-MEM2 and WJ-MEM3). In the case of HTKS and WJ-MEM, only those achieving a minimum performance level in the earlier sections can progress to the latter sections of the assessment.

In 2015, we also administered an IQ test to both sample A and almost all of sample C.[4] In particular, we administered seven components of the Wechsler Intelligence Scale for Children, which together constitute a short form of the WISC (Crawford *et al.* 2010), covering vocabulary, similarities, block design, matrix reasoning, coding, symbol search and digit span.

[4] Unfortunately, the final fieldwork occurred at a time when violence and social agitation were increasing in some of the areas of our study. This made it impossible to conduct a second visit to some households in sample C, when the WISC would have been administered to the child.

The age range at which each instrument is applicable varies across instruments. Throughout this paper, we standardise all scores to have mean zero and standard deviation 1 within age and within the sample. Height and weight are standardised using the World Health Organization growth standards.

5.3 Descriptive statistics

It is useful to begin with a basic description of the households in our sample. In order to maximise the cross-sectional sample size, for much of the analysis in this report we will put together samples A and C, yielding a total of 2,387 children. This corresponds to 55 per cent of the children in the original universe, and 63 per cent of the families interviewed in the 2008 survey.

In Table 1 (divided into 1A and 1B because of space constraints), we start by reporting basic characteristics for the focal child and the household. These are primarily characteristics that were measured before the lottery took place (income and family size taken from the lottery records), or were measured in 2008 and either can be safely assumed not to respond to lottery outcomes (such as race, sex or age of the child or respondent), or correspond to pre-lottery variables the respondent was able to remember when surveyed in 2008 (such as birth height and weight, or past preschool attendance).

We divide the sample between lottery winners and losers in the first two data columns in the table, and for each characteristic we report the difference between the two groups in the third column. All differences are adjusted by crèche–age group of lottery fixed effects, since the randomisation is valid within each of these groups. Standard errors for the raw and adjusted differences are clustered at the level of the crèche.

About half of the children in the sample are male, 25 per cent are white, 20 per cent are black and 55 per cent are mixed race children. On average, children were 7.2 years of age when they were interviewed (4–8 in 2012, and 7–11 in 2015).

Average birthweight in the sample is 3.2 kilograms, around the normal range, and average birth height is 49.2 centimetres. Just 34 per cent of mothers reported that the focal child in the study was a planned pregnancy, about 43 per cent of them are firstborn children, and the average age of the mother at birth was only 20.5. This indicates that the children in our study are primarily from fairly young mothers who did not plan the pregnancy.

In spite of that, almost every mother in the sample reported attending six or more prenatal care visits. Two thirds of children were born from a natural delivery, and 12–14 per cent were premature. Also, 77 per cent were breastfed up to six months of age.

Average monthly family income (deflated to 2015) was about R$920, which is close to US$233. The typical family in our sample has 4.6 individuals (meaning that average monthly family income per capita is about US$50, which is fairly low).

Almost all carers in the 2008 sample can read and write; 70 per cent have completed basic education, about 35 per cent completed secondary education and 1 per cent completed higher education.

There are basically no differences in these variables between lottery winners and lottery losers. The third column of Table 1 reports these differences and corresponding standard errors, after adjusting for lottery group fixed effects as described above. (We run a regression of each variable on an indicator for winning the lottery and age group–crèche fixed effects.) In the case of age of the focal child at the time of interview, there is a statistically significant difference between the two groups (at 10 per cent level of significance), equal to 0.04, but it is a very small number. There is also a very small but statistically significant difference between the proportion of carers who can read in the lottery winner and lottery loser groups.

Table 1: Means and standard deviations of variables for lottery winners and losers

1A **Focal child characteristics**	Loser	Winner	Regression adjusted difference	N
Male child	0.509	0.540	0.0286	2,387
	(0.500)	(0.499)	(0.0192)	
White child	0.249	0.247	0.00167	2,379
	(0.433)	(0.431)	(0.0173)	
Black child	0.183	0.191	0.00819	2,379
	(0.387)	(0.393)	(0.0168)	
Mixed race child	0.557	0.553	–0.0109	2,379
	(0.497)	(0.497)	(0.0200)	
Other race child	0.0104	0.00981	0.00107	2,379
	(0.101)	(0.0986)	(0.00529)	
Age of the child in months	7.219	7.189	–0.0408*	2,387
	(1.606)	(1.642)	(0.0218)	
Birthweight in kilos	3.190	3.193	0.0109	2,269
	(0.622)	(0.610)	(0.0298)	
Birth height in centimetres	49.19	49.29	0.201	2,256
	(4.145)	(4.139)	(0.184)	
Planned birth	0.339	0.347	0.00150	2,285
	(0.474)	(0.476)	(0.0237)	
Firstborn	0.435	0.420	–0.0146	2,281
	(0.496)	(0.494)	(0.0217)	
Age of the mother at birth	20.42	20.53	0.0540	2,283
	(4.998)	(5.113)	(0.223)	
6+ prenatal care visits	0.955	0.950	–0.00312	2,284
	(0.208)	(0.218)	(0.00964)	
Natural birth delivery	0.683	0.649	–0.0313	2,283
	(0.465)	(0.477)	(0.0215)	
Premature birth	0.121	0.143	0.0170	2,282
	(0.326)	(0.350)	(0.0154)	

1B **Household characteristics**	Loser	Winner	Regression adjusted difference	N
Breastfed up to 6 months	0.773	0.761	–0.0184	2,285
	(0.419)	(0.427)	(0.0198)	
Monthly family income	919.6	928.6	–0.503	2,014
(deflated to 2015)	(2,735.5)	(4,055.8)	(23.47)	
Family size	4.591	4.616	0.0194	2,023
	(3.656)	(4.047)	(0.141)	
Age of carer	29.89	29.44	–0.559	2,287
	(10.23)	(9.171)	(0.389)	
Carer can read and write	0.969	0.981	0.0136**	2,283
	(0.173)	(0.135)	(0.00652)	
Carer has at least basic education	0.690	0.709	0.0277	2,058
	(0.463)	(0.454)	(0.0212)	
Carer has at least secondary education	0.336	0.362	0.0301	2,058
	(0.473)	(0.481)	(0.0210)	
Carer has at least higher education	0.00703	0.0141	0.00509	2,058
	(0.0836)	(0.118)	(0.00429)	
Highest education grade completed by carer	4.847	4.719	–0.131	2,024
	(2.378)	(2.388)	(0.108)	

Note: This table reports pre-lottery variables for lottery winners and losers who were interviewed in either 2012 or 2015. There are a total of 2,387 children (1,462 from the 2012 round and 925 from the 2015 round not interviewed in 2012). The third data column reports the coefficients of a regression of each variable on lottery status (winner versus loser), which also controls for crèche–age group of lottery fixed effects. The last column reports the number of observations used for each variable. Standard errors are clustered at the crèche level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The fifth data column corresponds to the sample size for each variable. Recall that the maximum sample size is 2,387 (surveyed either in 2012 or 2015). Sex, age and race of the child were measured in either 2012 or 2015 and are available for nearly all the sample. The remaining variables, except income and family size, were measured in the 2008 survey. There are a little more than 100 observations missing for these variables, due to non-response to specific items. These two variables, family income and family size, are taken from the administrative lottery records, and are missing for a larger number of families, probably because of poorly recorded data. There are also a similar number of observations missing for carer's education, due to non-response to these questions.

In Table A1 in the Appendix, we reproduce these statistics for the sample of children and carers in the 2008 survey, regardless of whether they were interviewed in the 2012 or 2015 follow-up surveys. Our results are essentially the same: the sample is balanced.

6. Programme of policy: design, methods and implementation

The programme we study has been in place for several years in Rio de Janeiro. It consists of full-day care in public childcare centres. More precisely, the following services are provided: full-time day care, health services, food services, instructional toys and materials for children, and the involvement of parents to foster good parenting practices.

Crèches are fully managed by the municipal secretary of education, since early childhood services in Brazil are the responsibility of municipalities. They are an integral part of the municipality's strategy for early childhood education.

Therefore, this evaluation is about an existing and established programme. It examines a standard set of services that had already been in place, and been provided on a large scale, for several years. It had also been constantly expanded in the years prior to this study, not only in Rio de Janeiro but also in other municipalities across Brazil.

Nevertheless, there is some dispersion in the observed quality of crèches in Rio de Janeiro, documented in Barros *et al.* (2011). Moving from a low-quality to a high-quality day care centre may increase the development of the child along mental, physical and social dimensions, by about 0.2 standard deviations.

Moreover, it is possible that the day care centres in our sample are of better than average quality. It is only meaningful to have a lottery whenever there is an excess demand for vacancies, and this is more likely to happen if the centre is perceived to be of high quality, in which case our sample of centres may not be representative of the average centre (our study may have limited external validity). However, we should bear in mind that, in Barros *et al.* (2011), perceived quality of crèches by parents and observed quality by the researcher were basically unrelated, so it is possible that this is not a serious issue.[5]

[5] The lottery started with 25,538 applicants. Some 1,453 of them were not eligible. Eligibility was met if at least one of the following criteria was satisfied: 1) mother needs access to day care to be able to work; 2) total family income is below two minimum wages; 3) any member of the family has a chronic disease; 4) any member of the family has an alcohol or drug problem; 5) there are episodes of domestic violence in the family; 6) any family member has problems with law enforcement. The remaining 24,085 applicants applied for a slot in a specific day care centre, in a specific age group. We listed the day care–age group combinations for which there was excess demand for slots. There were 853 age group–crèche combinations but only 209 of them had enough excess demand to make a lottery feasible. The lottery allocated a random number to each applicant child, then ordered the children according to this number and admitted the first X children in the list, where X was the number of available slots. Depending on the size of the waiting list, each of the 209 age group–crèche combinations that made up the sample contributed 10 (77 groups), 20 (64 groups), 30 (42 groups) or 40 (25 groups) children to the sample, equally divided into treatment and control. There was an additional group with 38 children. We selected for the sample the children with X/2 highest (lottery winners) and X/2 lowest (lottery losers) lottery numbers in each group. These were the least likely to change status as a result of an increase in vacancies in the group or unexpected dropouts from the list of winners and losers. We end up with only 209 lottery groups out of 853 potentially oversubscribed ones, and therefore are unlikely to be similar to undersubscribed groups (for example, they have better quality on average, or are in areas where parents are motivated to send their children to day care). It is unlikely that our

In fact, using the lottery application records, we compared our sample with the overall sample of applications on three dimensions (available in that dataset): sex of the focal child, monthly family income and household size. Results are shown in Table A2 in the Appendix. There are tiny differences between our sample and the overall universe of applicants to the 2008 lottery across these three variables. None of these differences is statistically significant.

7. Impact analysis and results of key evaluation questions

7.1 Childcare attendance among lottery winners and losers – first stage

Winning the lottery in 2008 provided a child with an immediate slot in the childcare centre applied for. However, the child did not have to take up this place. Similarly, losing the lottery did not prevent children from accessing public childcare, since they could try to enrol in another centre or could wait one year and try to enrol in their preferred centre again, or apply for a new lottery place.

Therefore, we need to check whether, several years after the original randomisation, lottery winners were more likely to have attended childcare than lottery losers. We construct two variables measuring crèche attendance, which we then relate with winning or losing the lottery. The first variable is an indicator for whether a child ever attended a childcare centre since the first semester of 2005. The second variable corresponds to the number of semesters (since the first semester of 2005) a child attended a formal childcare centre.

Table 2: Differences in crèche enrolment between lottery winners and losers

	Ever in crèche	Number of semesters in crèche
Lottery winner	0.188***	1.179***
	(0.0192)	(0.125)
Observations	2,387	2,387
F-stat	87.49	80.71

Note: This table reports the impact of being a lottery winner on whether an individual ever attended crèche (data column 1), and on the number of semesters in crèche (data column 2), from regressions of each measure of crèche attendance on an indicator for winning the lottery, and crèche–age group fixed effects. F-stat is the F-statistic on the coefficient on being a lottery winner. Standard errors are clustered at the crèche level.
* p < 0.1, ** p < 0.05, *** p < 0.01.

sample is representative of all children eligible for crèches. Therefore, it is important to assess how our sample compares with the overall sample in terms of basic variables available in the lottery database.

About 80 per cent of the children in our sample attended a crèche at some point during their childhood. Among those who attended a crèche, the mean and median number of semesters spent at a crèche is five. There are some fairly high outlier values for these variables (the 99th percentile is 13 and the maximum is 18), which is based on self-report and relies on respondents' recollections of day care attendance. However, removing these outliers from the analysis results in almost no change in any of the estimates reported here.

We regress each of the crèche attendance variables on an indicator for whether the child was a lottery winner or loser, and age group–crèche fixed effects. Standard errors are clustered at the level of the crèche.

The results are displayed in Table 2. Winning the lottery leads to a 19 per cent increase in the likelihood that a child ever attended a crèche, and a 1.2 semester increase in the total number of semesters the average child attended a crèche, between 2005 and 2012 for those first interviewed in 2012, and between 2005 and 2015 for those first interviewed in 2015. (Although in practice it does not make a difference when the interview took place, since virtually no one attends day care after the age of three). These coefficients are statistically different from zero, with an F-statistic above 80, which means that the lottery result is a strong instrument for crèche attendance.

Although these coefficients are not large, they are definitely different from zero. Winning the lottery had a strong impact on crèche attendance. Therefore, we now proceed to examine the impact of winning the lottery on a large range of child, mother and household outcomes, in what is usually called an ITT analysis. We will also present IV estimates of the impact of crèche attendance on outcomes, where crèche attendance is instrumented with the lottery result.

This first stage relies on recall data, which is therefore imperfect. For example, respondents report that some children are still in day care in 2012, and even in 2015, which is impossible, since one can only attend a crèche up to the age of four. Reassuringly, very few children in 2012 are reported to be attending a day care centre: 25 in the first semester and 15 in the second semester. The same is true in 2015: five in the first semester and four in the second semester.

In order to examine the validity of our results to changes in this variable, we reconstructed day care attendance, so that in our data a child is only allowed to attend a day care centre in a given year if they are four years old or younger in that year. With this new definition, we reclassify 48 (out of 2,387) children as never having attended a day care centre, and the average number of semesters in day care in the sample falls from 4.1 to 3.6 (virtually all the discrepancy is due to the 2015 data, not due to the 2012 data). However, the first-stage estimates and the IV estimates are almost identical to the ones reported in the paper, and are shown in Appendix Table A3.

7.2 Impacts on child development

In this section, we compare child outcomes on a variety of dimensions between lottery winners and losers, and then present IV estimates of the impact of attending day care on these same variables. We will examine all of the outcomes described in section 5 with one exception: the ASQ. The ASQ was analysed in the 2013 version of this report and

there were no interesting results to report on that variable. Furthermore, it was not collected again in 2015 since the children were already too old for it.

The first outcomes we analyse are the height and weight of the focal child in each household. Using these measurements, we also construct their body mass index (BMI). Finally, we transform height, weight and BMI into z-scores (which have mean zero and standard deviation 1 within each age and gender group in the reference population), using World Health Organization data and software. The BMI and weight regressions omit outliers (those who weigh more than 100 kilograms). There are fewer observations for the weight for age (WFA) z-score than for either the height for age (HFA) or BMI for age (BFA) z-scores. This is because the World Health Organization only has standards for WFA up to the age of 10.

The first three data columns of Table 3A report estimates of the impact of winning the lottery on WFA, HFA and BFA. The estimated coefficients are large and statistically significant for all three outcomes. Children who won the lottery have, several years later, WFA, HFA and BFA that are about 11–12 per cent of a standard deviation higher than those who lost the lottery. On average, this corresponds to close to a 0.47 centimetre increase in height and a 900 gram increase in weight (we get these estimates if we use the raw variables in the regressions instead of the standardised ones, and control for age dummies in the regression).

The first three data columns of Table 3B report IV estimates of the impact of day care attendance on WFA, HFA and BFA. We present results for two different measures of attendance, using two different regressions. We estimate that an additional semester in childcare increases each of these measures by close to 10 per cent of a standard deviation. When we estimate instead the impact of attending (versus not attending) any crèche during childhood, we get effect sizes of between 57 per cent and 65 per cent of a standard deviation across measures. This is roughly consistent with the fact that, children who attend a crèche spend on average five semesters there.

These are very large effects. From our research design, we cannot tell whether they are due to day care attendance itself, or due to a change in home resources and environments. However, we present some evidence below suggesting that both channels may be operating simultaneously.

Data columns 4 and 5 of Table 3 look at two other outcome variables: an aggregate of cognitive tests and an aggregate of executive function tests. In order to construct the aggregate of cognitive tests, we first average the child's test results for the WISC, the TVIP, the WJ-VIS and the WJ-MEM tests. Then we standardise this average within sample, and within the age group, so that it becomes a variable with mean equal to zero and standard deviation equal to 1. The relatively small sample size for this index comes from using the WISC, for which we have a smaller sample than for the other cognitive tests. Nevertheless, results are essentially unchanged if we exclude the WISC from this index.

The executive function index is constructed in a similar way. We take simple averages of each child's results on the three executive function tests described above, although no child in our sample took all three tests (because of age restrictions). We then standardise the aggregate within the sample and age group.

We do not find any statistically significant impacts of crèche attendance on either cognitive or executive function scores. The magnitude of the IV estimates is nevertheless moderately large, especially when we look at the impact of ever having attended day care.[6]

Table 4 considers the last set of child outcomes, which are indices of frustration, attention, soothability, impulsivity and inhibition, taken from the CBQ and the TMCQ. These indices are standardised within age and sex (within sample). Contrary to the outcomes analysed in Table 3, which are all externally assessed by the interviewer, these items are all based on respondents' self-reporting.

The presentation of results (in this and in subsequent tables) follows the same logic as Table 3. We do not find substantial or statistically significant impacts of day care attendance on behaviour problems in children.

It is possible that the impact of the length of crèche attendance is nonlinear. Unfortunately, it is difficult to estimate IV models with nonlinear functions, especially with a binary instrument (the outcome of the lottery). In the Appendix, we implement a control function estimator, still recognising that identification may be partially driven by our choices of functional forms because of the discreteness of the instrumental variable.

We first estimate our first-stage regression for number of semesters in crèche and compute the residual, u. We then control for u, u^2 and u^3 in the outcome regressions (if we only include u, we replicate the IV results). Results are reported in figures A1–A7, and do not show any obvious non-linearity in length of crèche attendance.[7]

[6] In tables A4–A8 in the Appendix, we examine whether the ITT impacts reported in Table 3 vary according to the sex of the child, whether the child is white, whether the child is in the bottom half of the 2008 income distribution within the sample, and whether the child started attending day care before the age of two (which is likely to be endogenous). There are no obvious patterns of heterogeneity to report. Figures A9–A17 repeat this analysis for each component of the cognitive index (TVIP, WJ-MEM, WJ-VIS, WISC) and executive function (Pencil Tapping, Day and Night STROOP, Abstract Images STROOP, Colour STROOP, HTKS). The two interesting things to report are that: 1) when examined on its own, there is an ITT impact on WJ-MEM; and 2) for TVIP, WJ-MEM and WISC, there is an ITT impact among white, but not among non-white, children. When we look at the first-stage regression, there is no heterogeneity in the impact of winning the lottery on ever attending day care for white versus non-white children, while the impact of winning the lottery on the number of semesters in a crèche is larger for non-white children. This does not explain our results, given that our larger cognitive impacts are for white children. For reference and comparison with other studies, Table A18 in the Appendix shows means and standard deviations for all outcomes considered in the paper, by lottery status. Table A19 reproduces Table 3 for a new definition of day care attendance, where we recode reported day care attendance so that no child is allowed to be in a crèche after the age of four (as discussed above). Results are essentially the same as those in Table 3.

[7] The noteworthy thing to report in our results is that, with this specification, we detect a statistically significant impact of high levels of crèche attendance (five semesters and above) on inhibitory behaviours as reported by the carer (compared with zero semesters of crèche attendance).

Table 3: Impacts of attending crèche on height, weight, BMI and cognitive and executive function assessments

	HFA z-score	WFA z-score	BFA z-score	Cognitive z-score	Exec. function z-score
3A					
ITT					
Lottery winner	0.108**	0.114**	0.123*	0.0221	0.0119
	(0.0454)	(0.0566)	(0.0639)	(0.0422)	(0.0382)
3B					
IV					
Number of semesters	0.0916**	0.0966*	0.104*	0.0189	0.0106
in crèche	(0.0408)	(0.0496)	(0.0621)	(0.0361)	(0.0366)
Ever been in crèche	0.574**	0.627*	0.654*	0.118	0.0632
	(0.243)	(0.332)	(0.352)	(0.236)	(0.218)
Observations	2,354	2,167	2,349	1,935	2,100

Note: Table 3A reports the impact of being a lottery winner (ITT) on z-scores for HFA, WFA , BFA, an aggregate of cognitive scores (column 4) and an aggregate of executive function scores (column 5) from regressions of each of these measures on an indicator for winning the lottery, and crèche–age group fixed effects. Table 3B reports IV estimates of the impact of day care attendance on outcomes, based on two different measures used in two different regressions: the number of semesters in crèche, and of having ever attended a crèche. Standard errors are clustered at the crèche level. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 4: Impacts of attending crèche on indices of behaviour problems from the CBQ and TMCQ

	Frustration z-score	Attention z-score	Soothability z-score	Impulsivity z-score	Inhibition z-score
4A					
ITT					
Lottery winner	–0.000369	–0.0228	0.00328	–0.0451	0.0566
	(0.0429)	(0.0422)	(0.0445)	(0.0403)	(0.0394)
4B					
IV					
Number of semesters	_0.000313	–0.0193	0.00278	–0.0383	0.0481
in crèche	(0.0362)	(0.0365)	(0.0369)	(0.0344)	(0.0341)
Ever been in crèche	_0.00197	–0.121	0.0175	–0.241	0.302
	(0.246)	(0.230)	(0.227)	(0.236)	(0.204)
Observations	2,380	2,380	2,380	2,380	2,380

Note: Table 4A reports the impact of being a lottery winner (ITT) on five standardised indices of behaviour problems constructed from maternal self reports, from regressions of each of these measures on an indicator for winning the lottery, and crèche–age group fixed effects. Table 4B reports IV estimates of the impact of day care attendance on outcomes, based on two different measures used in two different regressions: the number of semesters spent in a crèche, and of having ever attended a crèche. Standard errors are clustered at the crèche level. * p < 0.1, ** p < 0.05, *** p < 0.01.

7.3 Impacts on household members' labour supply and home environments

In this section, we begin by examining the impact of access to free childcare on labour market outcomes of five sets of household members: 1) the parents of the focal child, 2) siblings, 3) uncles and aunts, 4) grandparents and 5) the carer. We only record information on an individual who lives in the same household as the focal child. While 1–4 are mutually exclusive categories, a carer may or may not be a relative of types 1–4. All individuals in this regression are aged 16 or above (for example, siblings of the focal child who are younger than 16 are excluded from the analysis).

All labour market data used in this paper is contemporaneous (measured either in 2012 or 2015). Unfortunately, it is not possible to report labour market outcomes for different household members at baseline, since there was not a baseline household survey. We have, however, baseline monthly household income from the lottery records, which was shown previously in this paper.

We consider four different labour market outcomes for each type of household member referred to above: 1) monthly income (in 2015 Reais, which is equal to zero if the individual did not work), 2) whether the individual was currently employed, 3) hours worked in the previous week (which equals zero if the individual was not employed), and 4) whether the individual paid social security contributions (an indicator of whether the individual was formally employed).

Table 5A is a 4 by 5 matrix, where each entry is the impact of winning the lottery on a combination of labour market outcome and type of household member. Each estimate comes from a separate regression of the labour market outcome and type of household member combination variable on winning the lottery and age group–crèche fixed effects, with standard errors clustered at the crèche level, as in the previous tables. Sample sizes differ substantially across the columns of this table because households differed widely in the number of resident parents, siblings, uncles, aunts and grandparents. We did not find any systematic differences between lottery winners and losers in household composition.

The group of relatives for whom we find systematic impacts of winning the lottery on labour market outcomes is grandparents. For this group, impacts are large and statistically significant for all four variables considered. There is also a suggestion of a child's day care attendance having an impact on the employment of siblings, although it disappears when we use IV, as shown below. If we split the sample by sex (available on request), we confirm the finding of no impact of winning the lottery on parental labour market outcomes (regardless of sex), while finding that the improvement in grandparent outcomes seems to be driven by females (grandmothers).

Grandparents lived in the same household as the child in 19.5 per cent of the families in our sample. Five per cent of the families had no parents in the household, 38 per cent had one parent in the household, and the remaining 57 per cent had two parents. There was at least one grandparent living in the same household in 80 per cent of the families with no parents in the household, 32 per cent of the families with one parent, and 6 per cent of the families with two parents. When the main caregiver lived in the same household as the child (96 per cent of all cases), this was a parent in 85 per cent of the

cases (6 per cent father; 79 per cent mother), and was a grandparent in 9 per cent of cases (0.4 per cent grandfather; 8.6 per cent grandmother). The most frequent principal caregiver was a child's mother, followed by their grandmother.

It is important to note that the median age of grandparents in our sample is 56. This means that the median grandparent in our sample was close to 50 years of age at the time of the lottery. Grandparents in our sample are young enough to be working full time.[8]

The IV results echo the ITT estimates. There are only robust large and statistically important impacts for grandparents. If we look at the second part of Table 5B, we see that grandparents whose grandchildren have ever attended day care have monthly incomes that are higher by about R$1,000 (US$250), are 73 per cent more likely to be currently employed, work 46 more hours per week, and are 88 per cent more likely to be paying social security contributions than grandparents whose grandchildren were never in day care. These numbers are surprising, not only because they are very large, but also because we see these differences several years after all children in the sample are out of childcare.

Table 5: Impacts of attending crèche on indices of household members' labour supply and income

		Family member				
		Parent	**Sibling**	**Uncle or aunt**	**Grandparent**	**Carer**
5A ITT						
Impact of winning the lottery on:	Monthly income	36.87	56.25*	4.422	217.3***	40.68*
		(25.94)	(33.15)	(53.37)	(77.63)	(21.97)
	N	3,631	503	433	623	2,288
	Currently employed	0.00978	0.0905*	–0.0583	0.152***	0.0401**
		(0.0140)	(0.0475)	(0.0603)	(0.0510)	(0.0189)
	N	3,608	501	418	621	2,265
	Hours of work per week	0.0787	0.685	1.245	8.843***`	1.514*
		(0.680)	(2.215)	(3.128)	(2.444)	(0.800)
	N	3,443	486	385	582	2,202
	Contributing to social security	0.00201	0.0362	–0.00965	0.185***	0.0100
		(0.0168)	(0.0340)	(0.0546)	(0.0533)	(0.0201)
	N	3,600	498	415	616	2,262

[8] It is interesting to note that, in our data, the probability that at least one adult other than the parent works is larger in families where both parents work (90%) than in families where one parent works (59%) or in families where no parent works (33%).

		Family member				
		Parent	**Sibling**	**Uncle or aunt**	**Grandparent**	**Carer**
5B IV						
Impact of the number of semesters in crèches on:	Monthly income	30.69	2.344	7.208	188.0*	35.22*
		(20.65)	(4.858)	(1175.0)	(108.3)	(20.25)
	N	3,631	3,440	433	623	2,288
	Currently employed	0.00820	0.0286	–0.122	0.131**	0.0351**
		(0.0117)	(0.0182)	(2.315)	(0.0631)	(0.0178)
	N	3,608	1,642	418	621	2,265
	Hours of work per week	0.0657	0.426	2.955	7.934	1.303*
		(0.540)	(0.688)	(244.6)	(6.021)	(0.710)
	N	3,443	1,623	385	582	2,202
	Contributing to social security	0.00169	0.00264	–0.0188	0.158	0.00877
		(0.0139)	(0.00871)	(0.455)	(0.0995)	(0.0168)
	N	3,600	1,639	415	616	2,262
Impact of having ever attended a crèche on:	Monthly income	198.3	16.68	32.72	1,032.3**	219.1*
		(142.8)	(35.37)	(30047.4)	(407.2)	(125.2)
	N	3,631	3,440	433	623	2,288
	Currently employed	0.0528	0.207	–0.468	0.726**	0.217**
		(0.0720)	(0.133)	(1.207)	(0.330)	(0.101)
	N	3,608	1,642	418	621	2,265
	Hours of work per week	0.424	3.039	11.39	46.20**	8.202*
		(3.937)	(4.729)	(156.6)	(18.74)	(4.904)
	N	3,443	1,623	385	582	2,202
	Contributing to social security	0.0108	0.0194	–0.0769	0.877**	0.0545
		(0.0919)	(0.0657)	(4.617)	(0.388)	(0.101)
	N	3,600	1,639	415	616	2,262

Note: Table 5A reports the impact of being a lottery winner (ITT) on four labour market variables, constructed for five types of household members. Each estimate corresponds to a different regression of each of these measures defined for each of these types on an indicator for winning the lottery, and crèche–age group fixed effects. Table 5B reports IV estimates of the impact of day care attendance on outcomes, based on two different measures used in two different regressions: the number of semesters spent in a crèche, and of having ever attended a crèche. Standard errors are clustered at the crèche level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

We also find impacts of the child having attended a crèche in their early years on the labour market outcomes of the individual designated as the carer when that individual is also a household member (which happens in more than 95 per cent of the households in our sample). Looking at the second part of Table 5B, we see that, when compared with those in households where children had not attended a crèche, the designated carers whose children had ever attended day care have monthly incomes that are higher by about R$220 (US$55), are 22 per cent more likely to be currently employed, work 8.2 more hours per week, and are 6 per cent more likely to be paying social security contributions (although this last estimate is not statistically different from zero).[9]

Our results are consistent with the findings in Barros *et al.* (2012), who analysed a 2008 survey of the main carers of the focal child. They are, however, quite distinct from the results in that paper for two reasons. Firstly, the data used in this report is much richer (allowing us to distinguish between different types of relatives). Secondly, the measurements were taken 4–7 years later (2008 in Barros *et al.* 2012, versus 2012 or 2015 in this report). By the first semester of 2012, almost every child in this sample was either in a school, preschool or crèche, which means that they had access to full-day care at the time of the survey (whereas in the 2008 survey, about 90 per cent of lottery winners were enrolled in crèches and only 50 per cent of lottery losers had access to crèches).

Barros *et al.* (2012) measured the employment of the focal child's (the mother in most cases) and household income in the second half of 2008, and found that enrolment of the child in a crèche led to a contemporaneous increase in the labour supply of the carer by 10 per cent, and an increase in household monthly income by R$92 (measured in 2008, corresponding to roughly R$151, or USD$38, in 2015). Both of these estimates were statistically different from zero. The 2008 survey does not include information on the monthly income of the carer, which could be compared to our estimates in Table 5.

In tables 6A and 6B, we show the impacts of crèche attendance on several household outcomes, including household monthly income. Each column shows a different outcome and, as in the tables just discussed, Tables 6AA and 6BA show ITT estimates, while tables 6AB and 6BB show IV estimates of the impact of two measures of crèche attendance on the outcomes we consider.

Winning the lottery in 2008 led to an average increase in monthly household income in 2012 or 2015 of about R$91 (around US$23 in 2015). Households of a focal child that had ever attended a crèche had a monthly income which is R$483 (US$121) higher than households whose child had never attended a crèche. Given that the average monthly household income in this sample was R$1,423 (US$356) and the standard deviation was $1,208 (US$302), this is a massive impact.

The rest of the tables also show that, in spite of these massive income effects, households who won the lottery do not have higher food expenditure than households who lost the lottery (which means that food shares have to decline substantially). Furthermore, although lottery winners were more likely than lottery losers to have at least one household member with a bank account (indicating some access to the financial system), they were not more likely than lottery losers to have at least one household member with a credit card.

[9] The change in the number of observations across columns in this table is mainly due to household composition. There are very few missing values in the labour market modules of our surveys.

Table 6: Impacts of attending crèche on household outcomes

Table 6A: Household income, assets and access to finance

	Household income	Food expenditure	Anyone with bank account	Anyone with credit card	Standardised asset index
6AA					
ITT					
Lottery winner	90.50**	20.02	0.0493**	0.0142	0.0631**
	(42.51)	(14.09)	(0.0221)	(0.0197)	(0.0307)
6AB					
IV					
Number of semesters in crèche	76.77**	16.88	0.0419**	0.0121	0.0535*
	(38.95)	(12.28)	(0.0206)	(0.0174)	(0.0275)
Ever been in crèche	482.6**	106.2	0.264*	0.0757	0.337*
	(228.1)	(83.74)	(0.139)	(0.103)	(0.185)
Observations	2,387	2,312	2,381	2,380	2,387

Note: Table 6AA reports the impact of being a lottery winner (ITT) on household income, household food expenditure, access to finance and a standardised asset index from regressions of each of these measures on an indicator for winning the lottery, and crèche–age group fixed effects. Table 6AB reports IV estimates of the impact of day care attendance on outcomes, based on two different measures used in two different regressions. Standard errors are clustered at the crèche level. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 6B: Reading to child and presence of books at home

	Frequent reading to child	Number of books in the home
6BA		
ITT		
Lottery winner	0.0469**	0.575**
	(0.0184)	(0.262)
6BB		
IV		
Number of semesters in crèche	0.0397**	0.489*
	(0.0176)	(0.251)
Ever been in crèche	0.250**	3.069**
	(0.105)	(1.401)
Observations	2,384	2,379

Note: Table 67BA reports the impact of being a lottery winner (ITT) on whether the child was frequently read to by someone in the household, and the number of books in the home, from regressions of each of these measures on an indicator for winning the lottery, and crèche–age group fixed effects. Table 6BA reports IV estimates of the impact of day care attendance on outcomes, based on two different measures used in two different regressions. Standard errors are clustered at the crèche level. * p < 0.1, ** p < 0.05, *** p < 0.01.

We also constructed an asset index (a durable goods index), based on the household ownership of a water filter, stove, refrigerator, freezer, washer, colour TV, computer, internet access, house telephone, cell phone and a car. We created indicators for whether each of these items existed in each household. In order to construct the asset index, we took the mean across indicators and then standardised it to have mean zero and variance 1 in the sample. Our estimates are that having a child attending full-time day care at an early age leads to an increase in the household asset index of about one third of a standard deviation, several years after the child left day care.

Finally, we examine two aspects of the home environment. The first variable is an indicator for whether the child was frequently read to by someone in the household. The second is the number of books in the home. For both these variables, we find very large and statistically important impacts of a focal child ever having attended full-time day care. In the Appendix, we report the impacts of access to crèches on additional measures of parental behaviours and home environments.[10]

7.4 Attrition

Most of the population in this sample lived in the slums of Rio de Janeiro, making fieldwork extremely hard. The most salient problem we faced in fieldwork is the attrition rate.

Of the 3,776 households interviewed in 2008, we were able to interview 1,462 in 2012 and 925 in 2015. The remaining families were lost for several reasons, which is standard in this type of study. This means that the attrition rate is about 37 per cent, several years after the initial sample was drawn. However, if we add to it the large attrition rate in the 2008 survey (noting that the initial sample drawn from the randomisation files included 4,348 children), the attrition rate relative to the original sample is closer to 45 per cent. Almost every case of attrition is due to the household not being found during the tracking exercise. There were very few refusals to participate once the household is contacted.

Before the fieldwork started, we hoped for lower attrition rates. However, we are now convinced that it would have been very difficult, if not impossible, to achieve such a goal for several reasons. Of the 3,776 households interviewed in 2008, the survey team attempted to trace about 60 per cent in 2012, four years after the initial survey, and 40 per cent in 2015, seven years after the initial survey. The time interval between the initial survey and the two follow-up surveys was very long. This is a population that is more mobile than average, and the vast majority of households not found are households who had moved.

[10] As we show above, many of the labour market impacts of crèche attendance seem to be driven by the behaviour of grandmothers. Therefore, we assess whether the impacts of winning the lottery on the household outcomes in tables 6A and 6B were driven by households where the grandmother was reported to be the main carer of the focal child in 2008 (versus the mother or the father). However, we recognise that this is an endogenous variable likely to respond to access to a day care slot (and therefore take these results as merely suggestive). We find that when the grandmother was the main carer of the child in 2008, the impacts of winning the lottery on household income and access to a bank account were larger than when another household member was the main carer. This is shown in Table A20. Table A21 reports ITT impacts of winning the lottery on additional household outcomes. Across all of these outcomes, there is no evidence of strong programme impact.

In addition, conducting surveys in very poor and potentially violent slums, like those in Rio de Janeiro, presents several challenges. For example, one event that severely delayed the fieldwork, and crippled the efforts of the survey team to reach households, was that a rumour of child kidnapping circulated in one of our 10 survey areas. In that area, households became very reluctant to open the door to strangers (the field workers). There were also instances of violence that prevented the survey team from entering some slums for substantial periods. It is instructive that of the 1,462 households interviewed in 2012, only 1,125 were re-interviewed in 2015 (the panel aspect of the fieldwork that we have not yet discussed), giving an attrition rate of 23 per cent in roughly three years. This is in spite of the survey firm being exactly the same, and therefore extremely familiar with the areas and the households in the sample from their work in 2012.

We are also convinced that, even though attrition rates are high, they do not significantly cripple the credibility of our study. In this section, we start by showing that there are only small differences in attrition rates between lottery winners and lottery losers. More importantly, we show that, across a very large range of variables, there is no evidence of differential selectivity in attrition between lottery winners and lottery losers.

Table 7 displays the differences in attrition rates between those who won and those who did not win a childcare place via the lottery. We consider two measures of attrition. The first compares the number of households found in the 2012 and 2015 surveys (2,387) with the number of households present in the sample drawn at the time of the lottery (4,348). The second measure compares the number of households found in the 2012 and 2015 surveys (2,387) with the number of households present in the 2008 household survey, conducted roughly six months after the lottery took place (3,776).

Table 7: Difference in the proportion of missing interviews between lottery winners and losers

	Interviewed in the 2012 and 2015 surveys	Interviewed in the 2012 and 2015 surveys
	Winners	Losers
Lottery participants	0.0301*	0.0267
	(0.0162)	(0.0167)
Observations	4,348	3,776

Note: This table reports differences in the proportion of individuals interviewed in the 2012 and 2015 survey waves, out of 1) the 4,348 households in the sample taken at the time of the lottery (data column 1), and 2) those 3,776 households in the sample interviewed in the 2008 survey (column 2). When estimating this difference, we controlled for crèche–age group fixed effects. Standard errors are clustered at the crèche level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Attrition rates are three percentage points higher among lottery losers than winners if we use the first measure. If we use the second measure, the difference is 2.7 percentage points. Only in the first case is this difference statistically significant, using a 10 per cent level of statistical significance. Regardless of the measure of attrition we use, these differences are quantitatively small and unlikely to cause significant contamination of our study.

What is more important is whether observable characteristics of attritors and non-attritors are selectively different across lottery groups, as shown in tables 8A to 8H. To assess this, we started by going back to the dataset collected by Barros *et al.* (2012), and also to two variables collected from lottery records. Although the Barros *et al.* (2012) dataset is itself contaminated by attrition, it provides the best source of data for our analysis.

Each of these tables has 3 panels: A, B and C. In Panel A we show the coefficient of a regression of each of the variables named at the top of the various columns of that table on an indicator variable for having been interviewed in 2012 or 2015, and age group–crèche fixed effects (not reported in the table), using only a sample of lottery winners. All variables are measured in the 2008 survey, except for a measure of monthly family income and another of family size, which come from the administrative lottery records. The source of data for each variable is also reported in the table, as is the sample size used in each regression.

Panel B in each table runs exactly the same regression, but this time for the sample of lottery losers. The coefficient of interest measures the extent to which there is selective attrition in these variables, within the sample of lottery winners (panel A in each table), and within the sample of lottery losers (panel B in each table).

Finally, in panel C of each table we pool all the data used in panels A and B, and run a regression of each of the variables named in the columns on an indicator for being a lottery winner, an indicator for being interviewed in 2012 or 2015, and an interaction of the two indicators. In bold, we report the coefficient and standard error on the latter interaction, which measures whether there is differential selective attrition between lottery winners and losers (as in a differences-in-differences research design, where the first difference is across being a lottery winner or loser, and the second is across being interviewed in 2012 or 2015, or not).

None of the coefficients in bold is statistically different from zero – generally, their magnitude is small. This strongly suggests that selective attrition is unlikely to be a severe problem in our study.[11]

We have also examined the robustness of our results to a correction for selective attrition. We focus on attrition from the 2008 to the 2012 and 2015 surveys, and ignore the initial attrition from the original sample to the 2008 survey because, unfortunately, we do not have data for a credible study of the importance of that attrition.

[11] We also looked at attrition from 2012–2015, and its relationship with the labour market status of adults in the surveyed households. As expected, families where adults worked were more likely to remain in the sample between 2012 and 2015. However, we cannot reject that attrition rates are different between families where (different types of) adults were more or less likely to work. Similarly, we checked and verified that, between 2012 and 2015, there is no differential attrition according to treatment status for focal children with different heights and weights.

Table 8: Differences in observable variables between households who were or were not interviewed in 2012 and 2015

Table 8A: Focal child's sex and race

Variables	Male child	White child	Black child	Mixed race child	Other race child
Source of data	2008 survey	2008 survey	2008 survey	2008 survey	2008 survey
	Panel A – lottery winners				
Interviewed in 2012 or 2015	–0.00390	–0.0315	0.00438	0.0258	0.00123
	(0.0247)	(0.0202)	(0.0162)	(0.0245)	(0.00849)
Observations	1,912	1,899	1,899	1,899	1,899
	Panel B – lottery losers				
Interviewed in 2012 or 2015	–0.00484	–0.0523**	–0.00656	0.0426*	0.0162*
	(0.0264)	(0.0242)	(0.0181)	(0.0246)	(0.00837)
Observations	1,855	1,849	1,849	1,849	1,849
	Panel C – whole sample – difference-in-differences				
Interviewed in 2012 or 2015*	**0.0114**	**0.0322**	**–0.00708**	**–0.0120**	**–0.0131**
* Lottery winner	**(0.0340)**	**(0.0288)**	**(0.0216)**	**(0.0302)**	**(0.0115)**
Observations	3,767	3,748	3,748	3,748	3,748

Table 8B: Focal child's age and birth characteristics

Variables	Age of the child (months)	Birth weight (kg)	Birth height (cm)	Planned birth	First-born
Source of data	2008 survey	2008 survey	2008 survey	2008 survey	2008 survey
	Panel A – lottery winners				
Interviewed in 2012 or 2015	–0.0158	–0.0228	0.179	–0.0209	–0.0239
	–0.306	–0.0351	–0.258	–0.0275	–0.0277
Observations	1,914	1,902	1,897	1,912	1,910
	Panel B – lottery losers				
Interviewed in 2012 or 2015	0.0169	0.00998	–0.0802	0.00897	–0.0299
	–0.327	–0.0312	–0.261	–0.029	–0.0269
Observations	1,862	1,840	1,825	1,858	1,854
	Panel C – whole sample – difference-in-differences				
Interviewed in 2012 or 2015*	–0.195	–0.025	0.324	–0.0218	0.00105
*Lottery winner	–0.417	–0.0412	–0.317	–0.0392	–0.0364
Observations	3,776	3,742	3,722	3,770	3,764

Table 8C: Focal child's antenatal care, birth and infant nutrition

Variables	Age of the mother at birth	Prenatal care	Natural birth delivery	Premature birth	Breastfed up to 6 months
Source of data	2008 survey	2008 survey	2008 survey	2008 survey	2008 survey
	Panel A – lottery winners				
Interviewed in 2012 or 2015	0.306	0.0175	–0.0420	0.0271	0.0272
	(0.228)	(0.0106)	(0.0255)	(0.0172)	(0.0209)
Observations	1,911	1,910	1,911	1,909	1,912
	Panel B – lottery losers				
Interviewed in 2012 or 2015	0.0435	0.00878	–0.0115	–0.00672	–0.00699
	(0.232)	(0.0117)	(0.0245)	(0.0157)	(0.0218)
Observations	1,856	1,855	1,857	1,853	1,858
	Panel C – whole sample – difference-in-differences				
Interviewed in 2012 or 2015*	**0.0583**	**0.00330**	**–0.0119**	**0.0272**	**0.0128**
*Lottery winner	**(0.309)**	**(0.0140)**	**(0.0329)**	**(0.0208)**	**(0.0293)**
Observations	3,767	3,765	3,768	3,762	3,770

Table 8D: Focal child's childcare and household characteristics

Variables	Had ever been in crèche before 2008	Was in a crèche in 2007	Stayed home in 2007	Household size	Monthly household income
Source of data	2008 survey	2008 survey	2008 survey	2008 survey	2008 survey
	Panel A – lottery winners				
Interviewed in 2012 or 2015	–0.00981	–0.0223	0.0224	0.116	35.49
	(0.0155)	(0.0155)	(0.0196)	(0.0968)	(26.62)
Observations	1,913	1,913	1,907	1,914	1,914
	Panel B – lottery losers				
Interviewed in 2012 or 2015	–0.0106	–0.0162	0.0402**	0.159*	–7.680
	(0.0141)	(0.0121)	(0.0184)	(0.0841)	(27.02)
Observations	1,860	1,858	1,850	1,862	1,862
	Panel C – whole sample – difference-in-differences				
Interviewed in 2012 or 2015*	**0.000869**	**–0.00100**	**–0.0206**	**0.0227**	**41.96**
*Lottery winner	**(0.0182)**	**(0.0172)**	**(0.0242)**	**(0.125)**	**(34.33)**
Observations	3,773	3,771	3,757	3,776	3,776

Table 8E: Carer's employment status, and household income and assets

Variables	Carer is employed	Monthly household income	Household size	House with water filter	House with stove
Source of data	2008 survey	Lottery records	Lottery records	2008 survey	2008 survey
	Panel A – lottery winners				
Interviewed in 2012 or 2015	0.00760 (0.0283)	–129.8 (163.6)	–0.242 (0.240)	0.0438* (0.0226)	0.00193 (0.00312)
Observations	1,894	1,823	1,839	1,914	1,914
	Panel B – lottery losers				
Interviewed in 2012 or 2015	–0.0189 (0.0245)	65.56 (69.57)	0.129 (0.132)	0.0425* (0.0252)	0.00156 (0.00238)
Observations	1,840	1,823	1,841	1,859	1,861
	Panel C – whole sample – difference-in-differences				
Interviewed in 2012 or 2015* *Lottery winner	**0.0274 (0.0331)**	**–221.8 (243.5)**	**–0.264 (0.242)**	**–0.0174 (0.0295)**	**–0.000887 (0.00432)**
Observations	3,734	3,646	3,680	3,773	3,775

Table 8F: Household consumer durables

Variables	House with refrigerator	House with freezer	House with washer	House with colour TV	House with computer
Source of data	2008 survey	2008 survey	2008 survey	2008 survey	2008 survey
	Panel A – lottery winners				
Interviewed in 2012 or 2015	0.0211** (0.00819)	0.0275 (0.0244)	0.0597** (0.0249)	0.00948 (0.00781)	0.0324 (0.0205)
Observations	1,909	1,909	1,908	1,913	1,911
	Panel B – lottery losers				
Interviewed in 2012 or 2015	0.00550 (0.0129)	0.0383* (0.0226)	0.0543** (0.0269)	0.0142* (0.00805)	0.0411** (0.0192)
Observations	1,861	1,853	1,851	1,861	1,858
	Panel C – whole sample – difference-in-differences				
Interviewed in 2012 or 2015* *Lottery winner	**0.0195 (0.0123)**	**–0.000806 (0.0318)**	**0.000856 (0.0352)**	**–0.00103 (0.00931)**	**–0.00404 (0.0266)**
Observations	3,770	3,762	3,759	3,774	3,769

Table 8G: Household assets, and carer's age and literacy

Variables	House with telephone	House with cell phone	Age of carer	Carer can read and write	Carer has at least basic education
Source of data	2008 survey	2008 survey	2008 survey	2008 survey	2008 survey
	Panel A – lottery winners				
Interviewed	0.110***	0.0239	0.707	–0.000227	0.00990
in 2012 or 2015	(0.0251)	(0.0225)	(0.517)	(0.00676)	(0.0207)
Observations	1,906	1,09	1,914	1,909	1,725
	Panel B – lottery losers				
Interviewed	0.0515*	0.0276	1.444***	0.00262	0.0307
in 2012 or 2015	(0.0270)	(0.0212)	(0.537)	(0.00963)	(0.0256)
Observations	1,859	1,861	1,862	1,859	1,679
	Panel C – whole sample – difference-in-differences				
Interviewed in					
2012 or 2015*	**0.0430**	**–0.00567**	**–0.790**	**–0.00785**	**–0.0268**
*Lottery winner	**(0.0329)**	**(0.0286)**	**(0.693)**	**(0.0109)**	**(0.0299)**
Observations	3,765	3,770	3,776	3,768	3,404

Table 8H: Carer's education level

Variables	Carer has at least secondary education	Carer has at least tertiary education	Highest education grade completed by carer
Source of data	2008 survey	2008 survey	2008 survey
	Panel A – lottery winners		
Interviewed	0.00691	–0.00223	0.0173
in 2012 or 2015	(0.0273)	(0.00643)	(0.125)
Observations	1,725	1,725	1,699
	Panel B – lottery losers		
Interviewed	0.00506	–0.0148**	0.0543
in 2012 or 2015	(0.0266)	(0.00735)	(0.128)
Observations	1,679	1,679	1,647
	Panel C – whole sample – difference-in-differences		
Interviewed in 2012 or 2015*	**–0.00611**	**0.0110**	**–0.110**
*Lottery winner	**(0.0342)**	**(0.00733)**	**(0.161)**
Observations	3,404	3,404	3,346

Note: Panel A in each of these tables show the coefficients on being an indicator variable for having been interviewed in 2012 or 2015, of a regression of each variable named at the top of each column on that indicator variable, age group–crèche fixed effects, using only a sample of lottery winners. The source of data for each variable is reported in the table, as is the sample size used in each regression. Panel B in each of these tables runs exactly the same regression for the sample of lottery losers. Panel C in each of these tables pools the data in panels A and B, and runs a regression of each of the variables named in the columns on an indicator for being a lottery winner, an indicator for being interviewed in 2012 or 2015, and an interaction of the two indicators. In bold, we report the coefficient and standard error on the latter interaction. Standard errors are clustered at the crèche level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

We explore the fact that, even within the same crèche–age group application pool, different interviewers visited different households in 2008. The identity of the interviewer visiting a household in 2008 turns out to be a statistically significant predictor of the future participation of that household in the 2012 or 2015 surveys (perhaps because some respondents were put off by a rude interviewer, or particularly enjoyed the

conversation with a very friendly interviewer). However, this is unlikely to predict the outcomes we are studying or the reporting of those outcomes (the 2008 survey, and the 2012 and 2015 surveys, were conducted by two different organisations).

We use this variation in a flexible control function estimator. We show in tables A22 and A23 in the Appendix that our main results in tables 3 and 5, respectively, change very little after we account for selective attrition this way.[12]

7.5 Some results from the panel

In this section, we add to the data just described in the 2015 repeat interviews of the households in the 2012 survey. We use the pooled data to re-estimate some of the ITT parameters presented above. We also add two additional variables to the regression: an indicator for the survey wave, and the interaction between this variable and the indicator for being a lottery winner. In other words, we estimate specification (3) presented under section 5.

We only conduct this analysis for a selected set of variables, because the survey instrument in the 2015 interviews was not completely equal to the one used in 2012. Therefore, in this section we use only the outcomes that exist in all three surveys: the 2012 survey, the 2015 interviews of the 2012 households, and the 2015 interviews of those households not interviewed in 2012. These outcomes are the focal child's height and weight, the labour market outcomes of different household members, and household income, food expenditure, financial access and asset index.

Table 9 shows ITT estimates for the three variables constructed from the anthropometric data: z-scores for HFA, WFA and BFA. We report two numbers for each outcome: the ITT for 2012 and the ITT for 2015. They are constructed from coefficients of the same regression. For example, going back to equation 3, if the wave indicator takes value 0 in the 2012 wave, and value 1 for the 2015 wave, then the estimate in the 2012 column is the coefficient on the lottery winner dummy, and the estimate in the 2015 column is the sum of the coefficient on the lottery winner dummy and the coefficient on the interaction between lottery winner and wave dummies.

Table 9: Impacts of attending crèche on height, weight and BMI in 2012 versus 2015

	HFA Z-score	WFA Z-score	BFA Z-score

[12] We start by regressing an indicator for whether a household was interviewed in 2008 and in 2012 or 2015 (versus being interviewed in 2008 but not subsequently), on 2008 interviewer fixed effects and on crèche–age group fixed effects (clustering the standard errors at the crèche level). Although in 62% of all crèche–age groups (corresponding to 55% of the children in the sample), all households were interviewed by the same person in 2008, in 38% of these groups (corresponding to 45% of the children) this was not the case. The 2008 interviewer identifiers are statistically significant predictors of participation of households in the 2012 or 2015 surveys even after accounting for crèche–age group fixed effects (F-stat = 4.2, p-value = 0.01). We then compute the predicted probability of being interviewed in 2012 or 2015, p, and we include it along with p^2 and p^3 in the outcome regressions. We present bootstrapped 90 per cent confidence intervals (CIs), taking into account the first-stage estimation of p, and clustering at the crèche level.

Year of measurement	2012	2015	2012	2015	2012	2015
Lottery winner	0.120**	0.0948*	0.155**	0.145	0.115	0.154*
	(0.0577)	(0.0518)	(0.0643)	(0.0878)	(0.0765)	(0.0903)
Observations	3,432		2,927		3,429	

Note: This table reports the impact of being a lottery winner (ITT) on z-scores for HFA, WFA and BFA from regressions of each of these measures on an indicator for winning the lottery, an indicator for survey wave (2012 and 2015), an interaction of these two indicators, and crèche–age group fixed effects. We report the implied impacts of winning the lottery in 2008 on outcomes in 2012 and in 2015, depending on when the measurements were taken. Standard errors are clustered at the crèche level. * p < 0.1, ** p < 0.05, *** p < 0.01.

Across outcomes, the ITT estimates for 2012 and 2015 have magnitudes in the same range. In no case can we statistically reject their difference from each other. However, the 2015 estimates are less precise than the 2012 estimates, even though we have a larger sample for 2015 than for 2012. This table suggests that, at least in terms of the anthropometric outcomes, we cannot reject that the ITT estimates do not change over time.

Table 10 shows ITT estimates for the labour market outcomes of different household members. In this case, across outcomes, the magnitude of the outcomes is substantially larger for 2012 than for 2015. However, once again we cannot reject that the 2012 and 2015 estimates are different, except in one case: the ITT estimates for the carer's hours of work are significantly higher in 2012 than in 2015.

Finally, Table 11 shows ITT estimates for household income, food expenditure, financial access and the asset index. As in Table 10, the point estimates are generally larger for 2012 than for 2015. However, in no case can we reject their difference.

In sum, our results appear to suggest that, even though the ITT estimates for several outcomes are large and statistically significant for those interviewed in 2012, they are smaller and less precise for those interviewed in 2015. However, we cannot rule out that the 2012 and 2015 estimates are indeed the same. Our results from the panel can be seen as suggestive but not definitive.

8. Discussion

In the previous section, we showed that access to formal childcare by poor children has strong impacts on their height, weight and BMI, more than four years after the children first enrolled in a crèche (at an age when virtually no child was still attending a crèche). These impacts are large in magnitude, they are statistically significant and we cannot reject that they last over time (although the latter conclusion is based on fairly imprecise data).

Table 10: Impacts of attending crèche on indices of household members' labour supply and income in 2012 versus 2015

		Family member									
		Parent		Sibling		Uncle or aunt		Grandparent		Carer	
		2012	2015	2012	2015	2012	2015	2012	2015	2012	2015
Impact of winning the lottery on:	Monthly income	43.52	50.32	29.23	43.33*	–9.094	–12.12	184.3**	64.35	54.60*	1.575
		(30.27)	(35.36)	(30.78)	(23.95)	(74.87)	(104.7)	(80.64)	(79.10)	(28.43)	(31.95)
	N	5,260		938		502		924		3,370	
	Currently employed	0.00383	0.0157	0.117**	0.0702**	–0.120**	–0.0302	0.164***	0.0905	0.0388	0.0142
		(0.0163)	(0.0161)	(0.0524)	(0.0342)	(0.0601)	(0.0664)	(0.0564)	(0.0601)	(0.0255)	(0.0204)
	N	5,238		933		500		922		3,358	
	Hours of work per week	0.527	0.0642	3.070	1.879	1.050	1.216	8.151***	3.711	2.263**	–0.0607
		(0.834)	(0.781)	(2.233)	(1.340)	(3.499)	(3.763)	(2.817)	(2.720)	(1.082)	(0.934)
	N	4,990		906		461		854		3,259	
	Contributing to social security	–0.0106	0.0179	0.0487	0.0295	–0.0150	–0.0305	0.204***	0.0784	0.0154	–0.0105
		(0.0207)	(0.0184)	(0.0347)	(0.0235)	(0.0543)	(0.0766)	(0.0517)	(0.0581)	(0.0244)	(0.0224)
	N	5,210		928		494		915		3,342	

Note: This table reports the impact of being a lottery winner (ITT) on labour market variables of different household members, in 2012 and 2015, from regressions of each of these measures on an indicator for winning the lottery, an indicator for survey wave (2012 and 2015), an interaction of these two indicators and crèche–age group fixed effects. We report the implied impacts of winning the lottery in 2008 on outcomes in 2012 and in 2015, depending on when the measurements were taken. Each combination of outcome and household member corresponds to a separate regression. Standard errors are clustered at the crèche level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 11: Impacts of attending crèche on household outcomes in 2012 versus 2015

	Household income		Food expenditure		Anyone in household with a bank account		Anyone in household with a credit card		Standardised asset index	
	2012	2015	2012	2015	2012	2015	2012	2015	2012	2015
Lottery winner	109.1**	68.16	26.64	2.748	0.0670**	0.0155	0.0171	0.0243	0.105***	0.0507
	(46.88)	(57.85)	(16.12)	(16.18)	(0.0260)	(0.0238)	(0.0235)	(0.0209)	(0.0331)	(0.0348)
Observations	3,511		3,389		3,504		3,500		3,512	

Note: This table reports the impact of being a lottery winner (ITT) on various measures of household income, finance and assets, from regressions of each of these measures on an indicator for winning the lottery, an indicator for survey wave (2012 and 2015), an interaction of these two indicators and crèche–age group fixed effects. We report the implied impacts of winning the lottery in 2008 on outcomes in 2012 and 2015, depending on when the measurements were taken. Standard errors are clustered at the crèche level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

These changes in height and weight may have occurred through two channels. First, because of the integral attention received in crèches, which includes nutritious meals, children may have grown up healthier. Second, because of the substantial increase in home resources in the short and medium term, parents may have been able to ensure better nutrition and access to better healthcare for their children. Regardless of the channel, these impacts are very large and illustrate an important role that public day care could potentially play in urban slums, even in middle-income countries such as Brazil.

We do not find statistically strong cognitive impacts on children who attended crèche, although our estimates of the impacts of crèche enrolment are quite large and positive. It is also relevant that we find no detectable adverse impacts of crèche enrolment on behavioural problems, as suggested by some recent literature on this topic (for example, Baker, Gruber and Milligan 2008; Belsky *et al.* 2007).

Especially striking are our results on the impact of winning the crèche attendance lottery on home resources and environments. Household income was much higher in households that won the lottery than in those that did not. In addition, the impacts on the lottery winning households' purchases of durable goods and assets, such as television sets, computers and cell phones, were larger than in the lottery loser group.

It is somewhat surprising that this increase in household resources did not seem to come from improvements in maternal employment outcomes. The earlier work of Barros *et al.* (2012) shows that, in the short term, access to childcare produced important gains in the labour supply of the focal child's carer, and in household income. In the data used in that paper, the large majority of carers were mothers, which remains true in more recent data.

Nevertheless, our findings are not inconsistent with Barros *et al.* (2012). Like them, we find that there was an increase in the labour supply of the household member designated as the focal child's carer, as well as an increase in household income (at least in the 2012 survey wave). What is different about our paper is that we are able to examine labour market outcomes for different household members, classified by their relationship to the child. Our most novel finding is that access to crèches in a child's early life has led to an improvement in labour market outcomes of *grandparents*. In analysis, available on request, we saw that this was driven primarily by grandmothers, not grandfathers.

Furthermore, when we reanalysed the data (again available on request) in Barros *et al.* (2012), we also saw suggestive evidence that the impacts on the carer's labour supply were larger when the carer was a grandparent. However, these results were not statistically significant, and the designation of who in the household was the carer could react endogenously to previous access to childcare.

It appears that access to full-day childcare freed up the time not only of the mother, but of grandparents (grandmothers), who became more able to invest in the labour market. In turn, this translated into better medium-term attachment to the labour market among mothers and grandparents, manifested in terms of their employment, earnings and having a formal job. In addition, it also led to additional resources in the home, which in turn translated into higher consumption of durables (which we subsume in the asset index).

Another consequence of improved home environments that resulted from access to free childcare in Rio de Janeiro is an observed increase in investments in children, namely reading to the focal child and acquiring books.

Such an increase could occur for several reasons. Parents could become more motivated to invest in children because they see an increase in their children's skills, or because they interact frequently with their children's teachers. Furthermore, the additional resources available in the home make additional investments in children possible, and probably also help to reduce stress in the home (which could be the result of financial strain).

Notice also that this increase in investing in children did not have to happen. If public and private investments in children are substitutes, then access to free public childcare could have crowded out home investments in children. Interestingly, what we observe was the opposite.

9. Specific findings for policy and practice

This report presents the first results of the evaluation of the impact of a large-scale childcare programme in Rio de Janeiro on child development, and maternal and household outcomes.

We collect an extremely rich dataset, which includes various direct child assessments, more standard assessments based on parental reporting, and a very detailed household survey.

We find quite strong impacts of the programme on children's height and weight, several years after they left the crèches. In addition, we also find strong impacts on a variety of household resources, and on investments in children, in terms of both time and goods. Remarkably, these are present even four and a half years after the initial randomisation, at a time when very few of the children in our sample still attended crèches. However, we do not find sustained impacts across children's cognitive or executive function test results.

We also find that access to day care centres resulted in large sustained increases in household income four and a half years after the lottery for childcare places, although these impacts become more muted over time. These gains in household income seem to be primarily associated with increases in the labour supply and income of grandparents in the household.

Online appendix

The appendix of this study is only available online and can be accessed from the link below.

http://3ieimpact.org/sites/default/files/2019-01/ie58-3ie-brazil-online-appendix.pdf

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The results showed strong impacts on anthropometrics outcomes of children several years after they left the crèches. It found that access to day-care centres resulted in sustained increases in household income associated with labour market outcomes of the grandparents. However, there were no robust impacts on cognitive skills, executive functions or family behaviour towards children's education. Nor were there changes in the other labour market outcomes for other family members.

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