ISSN 2763-5775 | www.rbaval.org.br

revista brasileira de avaliação

Experience report

Population-level monitoring of child development in two Brazilian municipalities

Acompanhamento de nível populacional do desenvolvimento infantil em dois municípios brasileiros

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HOW TO CITE: Janus, Magdalena, Vinoraj, Danusha, Reid-Westoby, Caroline, Cannitelli, Alyssa, & Duku, Eric. (2022). Population-level monitoring of child development in two Brazilian municipalities. *Revista Brasileira de Avaliação*, *11*(spe), e113622. https://doi.org/10.4322/rbaval202211036

Abstract

Early child development is important for the concurrent and future health and well-being of children. In this paper, we illustrate the feasibility and challenges of monitoring child development in Brazil. To address this goal, we used data collected using the Early Development Instrument (EDI). Data were collected for 2,621 children in 2011 and 2015 in two Brazilian municipalities. Crosstabulations and independent t-tests showed that demographics and child development outcomes were more similar than different between the municipalities, and that child development outcomes were consistently associated with family socioeconomic circumstances. A binary logistic regression revealed that participation in any early childhood education program appeared to be associated with children's developmental outcomes, but in a pattern not consistent across the years. Most importantly, our analyses also demonstrated that monitoring children's outcomes alone does not provide enough evidence to assess the causes of changes or impact of any broad measures implemented over time.

Keywords: Child development. Early Development Instrument. Population-level data.

Resumo

O desenvolvimento infantil precoce é importante para a saúde e o bem-estar atuais e futuros das crianças. Neste artigo, ilustramos a viabilidade e os desafios do monitoramento do desenvolvimento infantil no Brasil. Para atender a esse objetivo, utilizamos dados coletados utilizando o Instrumento de Desenvolvimento Precoce (EDI). Os dados foram coletados junto a 2.621 crianças em 2011 e 2015 em dois municípios brasileiros. Tabulações cruzades e testes de T independentes mostraram que perfil demográfico e os resultados de desenvolvimento infantil foram mais semelhantes do que diferentes entre os municípios, e que os resultados de desenvolvimento infantil foram consistentemente associados às circunstâncias socioeconômicas familiares. Uma regressão logística binária revelou que a participação em algum programa de educação na primeira infância parecia estar associada aos resultados de desenvolvimento infantil, mas em um padrão não consistente ao longo dos anos. Mais importante, nossas análises também demonstraram que o monitoramento dos resultados nas crianças de forma isolada não fornece evidências suficientes para avaliar as causas de mudanças ou impacto de quaisquer medidas amplas implementadas ao longo do tempo.

Palavras-chave*:* Desenvolvimento infantil. Instrumento de Desenvolvimento Precoce. Dados de nível. populacional

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Received: June 07, 2022
Accepted: July 26, 2022

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Introduction

Research and evidence on social determinants of health indicate that, in order to improve the well-being and health of all children, universal and equitable policies and practices addressing the perinatal period and early years, particularly for children living in disadvantaged circumstances, have the greatest chances of making a difference (Leseman & Slot, 2020; West, 2020). Affordable child care, preschool, and accessible parental leave are examples of such policies. However, their implementation faces many challenges: they may be costly (Richter & Samuels, 2018), difficult to implement and evaluate (Janus & Brinkman, 2010), and most of all, require significant support of local governments to succeed and continue (La Valle & Smith, 2009). Universal interventions can be contrasted with targeted programs, which focus on a specific group of people based on pre-defined criteria (Dodge, 2020). Targeted interventions may supplement what universal programs may otherwise not achieve on the large scale. However, trade-offs include potential labelling or stigmatizing children, high screening costs, and inconsistent inter-program quality or access (Offord et al., 1998). When programs are implemented, it is crucial to monitor the impact of these programs on child development to determine whether they bring improvements.

While there is substantial evidence for targeted developmental interventions, such as the Perry Preschool in the United States (Berrueta-Clement et al., 1984; Schweinhart, 2007) and Head start programs (Baker, 2011; Carneiro et al., 2015; Currie, 2001; Nores & Barnett, 2010; U.S. Department of Health & Human Services, 2010), the evidence for the benefits of universal programs in the early years is largely mixed (Baker, 2011; Blau, 2021). In particular, results are inconsistent regarding universal preschool (Baker, 2011; Dietrichson et al., 2020). In Canadian children, negative effects have been reported for behavioural and cognitive outcomes (Baker, 2011; Baker et al., 2008; Lefebvre & Merrigan, 2008), with the exception of positive behavioural outcomes for low-income children (Kottelenberg & Lehrer, 2013).

Relatively robust quasi-experimental evidence is provided by European universal preschool data, which has had both short- and long-term benefits for disadvantaged children and modest benefits for advantaged children (Blau, 2021). Five-year-old Norwegian children eligible for childcare subsidies achieved higher grade point average and oral exam grades (~0.3 SD) in junior high school (Black et al., 2012). A larger analysis of Norwegian children benefiting from this subsidy expansion (n = 499,026, birth cohorts 1967-1976), attained more years of education, had higher labour market participation, and reduced dependency on welfare programs, with girls and children of low-educated mothers benefitting the most (Havnes & Mogstad, 2011).

Some of the discrepancies in the findings across studies and countries may reflect differences in program quality assurance, rather than the inadequacy of universal programs. For instance, the South African universal "grade R" program, the first of its kind in sub-Saharan Africa, with a relatively high uptake, has potentially exacerbated school performance gaps between children from more and less privileged areas due to inconsistent program quality. The authors noted that the quality of this program was lower in less privileged areas where children may have, paradoxically, benefited the most (Richter & Samuels, 2018). Moreover, a 9-month structured preschool curriculum improved math, executive function, and language scores in 5-year-old Norwegians compared to controls — who were all enrolled in universal preschool (Rege et al., 2019). Importantly, the effects of the curriculum were driven by improvements in the skills of children attending preschools identified as low quality at baseline, implying that program quality, and not just access, was critical in addressing early child inequities.

Disadvantaged children seem to benefit most from universal interventions (e.g., Dietrichson et al., 2020), yet are least likely to enroll in these programs (Blau, 2021; Cornelissen et al., 2018; Havnes & Mogstad, 2011). Thus, the success of universal programs may continue to be underestimated and under-realized until explicit strategies are designed to circumvent these problems.

Until late in the twentieth century, the two most accessible population-level health and development statistics on children were birth outcomes (e.g., % live births) and enrollment in

grade school. With the advent of Early Grades Reading Assessment (EGRA) and Early Grades Math Assessment (EGMA) (Education and Policy Data Center, 2013) completed by children at about 8 years of age (at about grade 2 or 3), limited information on children's mastery of reading and mathematics became available.

Over the last twenty years, there have been many efforts to improve local and global monitoring of early child development. Specifically formulated as one of the targets in the Sustainable Development Goal 4, finalized in 2015 (United Nations, 2022) Target 4.2[1] focuses on reporting percentages of children under 5 years old who are developmentally on track in health, learning, and psychosocial development. Among several measures existing before 2015, reporting on child development at the population level prior to learning in grade school, that contributed data to the formulation of Target 4.2, has been the Early Development Instrument (EDI; Janus & Offord, 2007).

The EDI is a teacher-completed assessment, originally developed in Canada in the late 1990s (Janus & Offord, 2007). It has been extensively validated as an assessment of child development (Janus & Reid-Westoby, 2016). For instance, several researchers have examined and confirmed the construct validity (Guhn et al., 2011; Hymel et al., 2011; Janus & Offord, 2007), predictive validity (Davies et al., 2016, 2021; Duncan et al., 2020; Forget-Dubois et al., 2007), between-group validity (Guhn et al., 2007; Muhajarine et al., 2011), as well as cross-cultural validity (Brinkman et al., 2017; Georg et al., 2020; Ip et al., 2013; Janus et al., 2011) of the EDI. The EDI has subsequently been translated and adapted for use in other countries, one of which was Brazil.

The instrument's feasibility and holistic focus on early child development was considered an asset in the Foundation Maria Cecilia Souto Vidigal (FMCSV)'s innovative funding initiative to enhance integration and programs in the area of early childhood, with a long-term objective to enhance the overall developmental skills of all children in the community. Initiatives such as this, fostered by a charitable foundation or a non-government organization, are often driven by the need to demonstrate initial positive effects of programs implemented in the early years to advocate for continuous support and funding.

Current study

In 2011, FMCSV funded several municipalities in the state of São Paulo, Brazil, to encourage a multisectoral integration in the early years. One of the evaluation strategies included collecting information on the developmental status of children prior to school entry, at about 5 years of age, using the EDI. In two municipalities, called here Southcity and Northcity, data on child development were collected at two points in time: in 2011 and in 2015. In this paper, we illustrate the feasibility and challenges of monitoring child development and highlight the value of placing the interpretation of such population-level data in relevant context. In order to do so, we 1) provide a descriptive comparison of child demographics and child developmental outcomes at these two points in time, 2) describe the results separately for each municipality, and 3) examine the contribution of the demographic characteristics and reported participation in early childhood education (ECE) programs to children's EDI outcomes for each site.

Methods

Study design and sample

A cross-sectional study examining the feasibility of monitoring early child development in two Brazilian municipalities was conducted. The study sample came from two years of data collection: 2011 and 2015. The first population-wide implementation of the EDI (see description of the instrument below) was carried out in Southcity and Northcity between June

[1] By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education (United Nations, 2022)

and September 2011; the second in November 2015. Both times, all 5- and 6-year-old children enrolled in their second year of public preschool were included in the study.

The sample comprised 1,312 children in Southcity and 1,282 children in Northcity. Criteria for inclusion in the analyses were (a) international comparability, children between the ages of 3.5 and 7.5 years, (b) having no more than one EDI domain missing, (c) not classified as having special needs, and (d) being in a class for at least one month. Based on these criteria, in the 2011 sample, 5 children were excluded because they were not in class for more than one month and 19 children were excluded for having special needs. In the 2015 sample, 2 children were excluded for having scores for more than one EDI domain missing, and 32 children were excluded due to a special needs classification. Therefore, the final sample used for the 2011 analyses included 1,151 children: 587 in Southcity, and 564 in Northcity, while for the 2015 analyses, there were 1,470 children: 752 in Southcity and 718 in Northcity.[2]

Measures

Early Development Instrument (EDI)

The EDI is a teacher-completed, 103-item measure of children's ability to meet developmental expectations across five domains: physical health and well-being, social competence, emotional maturity, language and cognitive development, and communication skills and general knowledge (Janus & Offord, 2007). These domains are further broken down into 16 subdomains (see Table 1). The EDI has been validated in numerous countries, including Brazil, and demonstrates good psychometric properties in each of these contexts (Janus et al., 2014; Janus & Reid-Westoby, 2016).

Table 1. The five developmental domains of the EDI, the number of items in each domain, and the subdomains comprising each domain.

Domains	Number of items	Subdomains
Physical health & well-being	13	Physical readiness for school day Physical independence Gross and fine motor skills
Social competence	26	Overall social competence Responsibility and respect Approaches to learning Readiness to explore new things
Emotional maturity	30	Prosocial and helpful behavior Anxious and fearful behavior Aggressive behavior Hyperactive and inattentive behavior
Language and cognitive development	26	Basic literacy Interest in literacy/numeracy and memory Advanced literacy Basic numeracy
Communication skills and general knowledge	8	Communication skills and general knowledge

The main outcome variables on the EDI are domain scores and vulnerability. Domain scores are calculated by averaging all the items comprising each domain. They range from 0 (lowest level of ability) to 10 (highest level of ability) (Janus & Offord, 2007). Children with mean

[2] While we understand that additional information was collected from the municipalities by the implementation team in 2009-2012, it was a separate component of the project and therefore not included in the present report.

scores below the 10th percentile of the baseline population, are considered vulnerable in that domain; those with "vulnerable' scores on 1 or more domains are vulnerable overall. The overall vulnerability at age 5 is highly predictive of future academic and social difficulties (Davies et al., 2016; Guhn et al., 2016).

The EDI questionnaire also includes questions on children's demographic characteristics, variables associated with placement designation in school (i.e. special needs status, type of class etc.), and prekindergarten experience. Child and family-level variables were derived from the demographic section on the EDI, specifically customized for the Brazilian context. Child-level demographic variables included sex, age at the time of EDI completion, and participation in any form of ECE. Family-level variables included two indicators of family socioeconomic status: earning a minimum wage or earning higher wage; participation in the Bolsa Família[3] program or not; and family status: child lives with both parents or not, and number of household members.

Brazil's adaptation of the EDI

The adaptation of the Brazilian version of the EDI from the original Canadian English version occurred in 2010 and consisted of several steps. First, it was translated into Portuguese, and, based on the input of Brazilian experts, minor adaptations were made to the wording to ensure a fit with the Portuguese language and the Brazilian context. For instance, modifications were made to the demographic components of the questionnaire to meet the needs of the FMCSV's program and to acquire additional background information on the children's families. The instrument was then back-translated into English to confirm accordance with the original version. Evidence from the first wave of EDI implementation in the FMCSV project indicated adequate validity of the EDI in Brazil (Janus et al., 2014). Final approval was based on a rigorous process of translation, back translation, and revision to consensus in close consultation with the EDI authors. Results of the evaluation of the Primeira Infacia Melhor in Rio Grande do Sul (Ribeiro et al., 2018) provided additional evidence on the feasibility and reliability of the Brazilian version of the EDI in the context of measurement of the impact of early intervention.

Analytic strategy

EDI domain scores were computed for children with valid data and the analyses were performed using SPSS version 28.0.1.0 (IBM Corp., 2021).

Child characteristics such as age and sex, type of class, and family-level variables (i.e. income, family structure) and child development (EDI) outcomes were used to compare the samples between the two implementations for the two municipalities combined at each time point. Crosstabulations, independent t-tests and appropriate effect sizes, (Cohen's d for t-tests and Cramer's V for crosstabulations), were computed for the comparisons. Next, we stratified the data by municipality and performed the same analysis within each municipality over time. The recommended interpretation of effect sizes for Cramer's V was: negligible 0 < .1; small .1 < .3; medium .3 < .5; and large .5 or more. The interpretation of effect sizes using Cohen's d was: minimal 0<0.2; small 0.2<0.5; medium 0.5<0.8; and large >0.8. Third, we examined the association of demographic characteristics with overall EDI vulnerability for each community with year as a control variable using binary logistic regressions. Last, we examined the association of ECE participation with EDI at both time points.

[3] The Bolsa Família program was established in 2003 in an effort to improve efficiency and coherence of the social safety net and to scale up assistance for the poor. In March 2022, the program was replaced by a new similar program called "Auxilio Brazil." Bolsa Familia provided cash transfer benefits ranging from R$85-170 (US$26-52) per person per month with benefit values dependent on family composition and extent of impoverishment (Gazola Hellman, 2015; Lindert et al., 2007). The cash transfer had both education and health conditionalities. Children of recipients had to be enrolled in a primary school program with an 85% attendance rate. Families had to also adhere to the recommended vaccine schedule, attend regular health checkups, follow up with consistent growth monitoring for children, and access pre- and post-natal checkups for women.

Results

Demographic characteristics and EDI results for the 2011 and 2015 full samples

The 2011 sample comprised 1,151 children (52% boys and 48% girls) with a mean age of 5.40 years. The final sample for the 2015 data collection consisted of 1,470 children (51% boys and 49% girls) with mean age of 5.88 years (Table 2). There were meaningful (medium to large effect sizes) differences between the two implementations in children's age, with children being older in 2015, numbers of day missed at school (more in 2015), household composition (smaller in 2015), and participation in ECE (less in 2015). There were also more families participating in the Bolsa Familia program in 2015 than in 2011 (20.5% vs. 15.5%), but the effect size of this difference was very small (0.06).

Table 2. Descriptive statistics of selected 2011 and follow-up 2015 samples.

Characteristic	N (%) - 2011	N (%) - 2015	Effect size (Cohen's d)	Fisher's exact test p-value
Male	598 (52)	721 (51)	0.01	0.637
Participation in the Bolsa Familia Program	177 (15.5)	297 (20.5)	0.06	0.001
Monthly Income of the Family up to minimum wage	223 (21.3)	292 (21.5)	<0.01	0.920
Child lives with at least one biological parent	920 (80.1)	1120 (76.5)	0.04	0.032
ECE participation	324 (28.1)	406 (74.8) [1]	0.44	<0.001
	Mean (SD) - 2011	**Mean (SD) - 2015**	**Effect size (Cramer's V)**	**t, df, p-value**
Age (at EDI implementation)	5.40 (SD=0.32)	5.88 (SD=0.31)	-1.55	-39.28, 2617, <0.001
Days absent from school	7.41 (SD=8.73)	12.05 (SD=10.78)	-0.47	-12.17, 2475.93, <0.001
Number of household members	4.18 (SD=1.22)	3.31 (SD=1.50)	0.72	18.25, 2487.26, <0.001

[1]Sample size for this variable was 543 (36.9% of the total sample) in 2015 due to missing responses.

Note: N = number; SD = standard deviation; t = t-statistic; df = degrees of freedom.

Child development

There were also differences in children's developmental status between the years. Compared to the mean EDI domain scores in 2011, the mean EDI domain scores were lower in 2015 for all domains, except for language and cognitive development (see Table 3). The differences in social competence, emotional maturity, and communication and general knowledge were of moderate effect size. Consequently, there were more children in the vulnerable range in 2015 than in 2011, except for language and cognitive development; the difference in social competence was a small effect size.

Site demographics and child development

Considering that the sample consisted of two separate sites at each time, we explored the demographics and child development by site and by year to gain understanding of generalizability of the results found in the full sample. Tables 4 (a and b) show demographic characteristics for the two sites in 2011 and 2015; and Table 5 (a and b) the EDI domain means and percent vulnerable for Southcity and Northcity, respectively.

Table 3. Descriptive statistics for EDI domain scores and vulnerability in 2011 and 2015.

Domain Scores	2011 Mean (SD)	2015 Mean (SD)	Effect size (Cohen's d))	t-statistic, df, p-value
Physical health and well-being	9.48 (1.00)	9.39 (1.01)	0.09	2.35, 2619, 0.019
Social competence	8.81(1.50)	8.31 (1.79)	0.30	7.78, 2475.89, <0.001
Emotional maturity	8.23 (1.57)	7.73 (1.64)	0.31	7.87, 2513.80 <0.001
Language and cognitive development	7.46 (1.83)	7.63 (1.92)	-0.09	2.29, 2612, 0.022
Communication and general knowledge	8.98 (1.74)	8.59 (2.09)	0.20	5.16, 2608.81, <0.001
Vulnerability	**2011 N (%)**	**2015 N (%)**	**Effect size (Cramer's V)**	**Fisher's exact test**
Physical health and well-being	115 (10.0%)	178 (12.1%)	0.03	0.092
Social competence	111 (9.6%)	267 (18.2%)	0.12	<0.001
Emotional maturity	102 (8.9%)	184 (12.5%)	0.06	0.003
Language and cognitive development	111 (9.7%)	143 (9.7%)	<0.01	1.000
Communication and general knowledge	88 (7.6%)	186 (12.7%)	0.08	<0.001
Overall Vulnerability	283 (24.6%)	447 (30.4%)	0.06	<0.001

Note: N = number; SD = standard deviation; df = degrees of freedom.

Similar to the full sample, there were equal proportions of male and female children in both sites at both time, children were older in 2015 and missed more school days; also children lived in smaller households. There were more families participating in Bolsa Familia children in 2015, although the magnitude of the difference was not the same in both sites. While in the combined sample there was no difference in income between the two years, in Southcity there was a lower percentage of families with low income in 2015; while in Northcity there was a higher percentage in 2015 than in 2011.

When child development outcomes were examined, much the same pattern emerged. Majority of differences between 2011 and 2015 remained, in that children in both sites had lower mean scores and higher vulnerabilities in Physical health and well-being, Social competence, Emotional maturity, and Communication and general knowledge in 2015 versus 2011. Some inconsistencies emerged in the vulnerability in the Language and cognitive development domain: in Southcity the percentage of vulnerable children was higher in 2015, but in Northcity it was lower (though not meaningfully) than in 2011. It is also worth noting that while the overall vulnerability in the full sample increased from 24.6% in 2011 to 30.4% in 2015, in Southcity it increased from 27.6% to 33.5% and in Northcity from 21.5% to 27.2%. In other words, the higher percentage in Northcity in 2015 was at the same level as the lower percentage in Southcity in 2011, illustrating somewhat uneven starting points for these two municipalities – a finding that can only be established when data are considered at local area level.

Demographic characteristics and EDI outcomes

Next, we examined the association of demographic variables with the EDI vulnerability controlling for the year of implementation, separately for each municipality. For children in each municipality being male, participation in Bolsa Familia, and missing school were associated with an increased risk of vulnerability in one or more EDI domains (1.56, 2.91, and 1.04 times,

Table 4. Demographic characteristics between 2011 and 2015, displayed separately for Southcity and Northcity.

(a) Southcity				
Characteristic	**N (%) - 2011**	**N (%) - 2015**	**Effect size (Cramer's V)**	**Fisher's exact test**
Total N	587	752		
Male	307 (52.3)	389 (51.7)	0.01	0.869
Participation in the Bolsa Familia Program	78 (13.5)	147 (19.7)	0.08	0.003
Monthly Income of the Family up to minimum wage	129 (23.0)	123 (18.2)	0.06	0.040
Child lives with at least one biological parent	477 (81.4%)	601 (79.9)	0.02	0.531
Characteristic	**Mean (SD) - 2011**	**Mean (SD) - 2015**	**Effect size (Cohen's d)**	**t statistic, df, p-value**
Age at EDI implementation	5.44 (0.34)	5.88 (0.32)	-1.34	-24.13, 1216.76, <0.001
Days absent from school	6.94 (6.72)	10.84 (9.55)	-0.46	-8.75. 1323.59, <0.001
Number of household members	4.37 (1.30)	3.41 (1.27)	0.75	13.57, 1237.65, <0.001
(b) Northcity				
Characteristic	**N (%) - 2011**	**N (%) - 2015**	**Effect size (Cramer's V)**	**Fisher's exact test**
Total N	564	718		
Male	291 (51.6)	360 (50.1)	0.01	0.613
Participation in the Bolsa Familia Program	99 (17.6)	150 (21.4)	0.05	0.102
Monthly Income of the Family up to minimum wage	94 (19.3)	169 (24.8)	0.06	0.028
Child lives with at least one biological parent	443 (78.7%)	519 (72.9)	0.07	0.018
Characteristic	**Mean (SD) - 2011**	**Mean (SD) - 2015**	**Effect size (Cohen's d)**	**t statistic, df, p-value**
Mean Age (at EDI implementation)	5.35 (0.30)	5.88 (0.30)	-1.80	-32.0,1215.63, <0.001
Mean days absent from school	7.90 (10.40)	13.34 (11.82)	-0.49	-8.73, 1250, <0.001
Mean number of household members	3.98 (1.10)	3.15 (1.25)	0.70	12.49, 1314, <0.001

Note: N = number; SD = standard deviation; df = degrees of freedom.

respectively). In Southcity only, income up to the minimum wage also contributed to the EDI vulnerability (increasing the odds 1.94 times), while in Northcity only, children not living with least one biological parent did (increasing the odds 1.47 times) (Table 6).

Participation in the early childhood education

Finally, we examined the reported participation in any ECE program at each time point in each municipality. Our intention was to use logistic regression to assess the relative contribution of participation to EDI outcomes at both times, however, the proportion of missingness in the 2015 data collection made modelling analyses not viable, while methodologies to examine,

Table 5. Comparison of EDI domain scores and vulnerability in each of the municipalities between 2011 and 2015.

(a) Southcity				
Domain Scores	**Mean (SD) - 2011**	**Mean (SD) - 2015**	**Effect size (Cohen's d)**	**t-statistic, df, p-value**
Physical health and well-being	9.42 (1.10)	9.35 (1.00)	0.05	1.01, 1337, 0.314
Social competence	8.56 (1.64)	8.13 (1.82)	0.24	4.45, 1310.04, <0.001
Emotional maturity	8.06 (1.65)	7.59 (1.62)	0.29	5.25, 1333, <0.001
Language and cognitive development	7.48 (1.81)	7.65 (1.96)	-0.09	-1.65, 1293.76, 0.099
Communication and general knowledge	8.77 (1.96)	8.51 (2.14)	0.13	2.31, 1303.15, 0.021
Vulnerability	**N (%) - 2011**	**N (%) - 2015**	**Effect size (Cramer's V)**	**Fisher's exact test**
Physical health and well-being	69 (11.8)	102 (13.6)	0.03	0.364
Social competence	76 (12.9)	162 (21.5)	0.11	<0.001
Emotional maturity	68 (11.6)	101 (13.5)	0.03	0.321
Language and cognitive development	53 (9.1)	81 (10.8)	0.03	0.359
Communication and general knowledge	65 (11.1)	105 (14.0)	0.04	0.117
Overall vulnerability	162 (27.6)	252 (33.5)	0.06	0.020
(b) Northcity				
Domain Scores	**Mean (SD) - 2011**	**Mean (SD) - 2015**	**Effect size (Cohen's d)**	**t-statistic, df, p-value**
Physical health and well-being	9.55 (0.89)	9.42 (1.01)	0.13	2.43, 1265.72, 0.015
Social competence	9.07 (1.29)	8.49 (1.75)	0.37	6.86, 1274.97, <0.001
Emotional maturity	8.40 (1.46)	7.89 (1.65)	0.33	5.974, 1261.67, <0.001
Language and cognitive development	7.44 (1.86)	7.61 (1.87)	-0.09	-1.60, 1277, 0.109
Communication and general knowledge	9.19 (1.44)	8.68 (2.04)	0.29	5.32, 1267.55, <0.001
Vulnerability	**N (%) - 2011**	**N (%) - 2011**	**Effect size (Cramer's V)**	**Fisher's exact test**
Physical health and well-being	46 (8.2)	76 (10.6)	0.04	0.151
Social competence	35 (8.2)	105 (14.6)	0.13	<0.001
Emotional maturity	34 (8.0)	83 (11.6)	0.09	<0.001
Language and cognitive development	58 (10.3)	62 (8.7)	0.03	0.335
Communication and general knowledge	23 (4.1)	81 (11.3)	0.13	<0.001
Overall Vulnerability	121 (21.5)	195 (27.2)	0.07	0.019

Note: N = number; SD = standard deviation; df = degrees of freedom.

understand and deal with the missingness mechanisms are beyond the scope of this study. Therefore, we present the results in a descriptive manner.

There seemed to be a marked increase in the participation in ECE between years 2011 and 2015 (from 28.1% to 74.8%, Table 2), however, it was likely due to over 70% missing responses on that variable. There were some demographic differences between the sites (Table 7): in Northcity, at both times, there were more children participating in the Bolsa Familia Program and having low income among those attending ECE than those that did not; no such pattern was observed in Southcity. Despite this, the pattern of association between ECE and mean EDI scores was remarkably similar between sites in 2011, but opposite in 2015. In 2011, in

Table 6. Results of the logistic regressions examining the associations between the demographic variables and children's developmental vulnerability, by municipality.

Southcity	Odds Ratio (95% CI)	Wald	d.f.	p-value
Male	1.56 (1.10-2.24)	5.939	1	0.015
Participation in the Bolsa Familia Program	2.91 (1.90-4.47)	23.838	1	<0.001
Monthly Income of the Family up to minimum wage	1.95 (1.27-2.97)	9.443	1	0.002
Number of household members	0.99 (0.86-1.13)	0.034	1	0.853
Child does not live with either biological parent	0.92 (0.60-1.44)	0.122	1	0.727
Days Absent	1.04 (1.02-1.06)	16.499	1	<.001
Year 2015	1.09 (0.73-1.63)	0.178	1	0.673
Northcity	**Odds Ratio (95% CI)**	**Wald**	**d.f**	**p-value**
Male	1.87 (1.41-2.48)	18.938	1	<0.001
Participation in the Bolsa Familia Program	1.66 (1.12-2.47)	6.339	1	0.012
Monthly Income of the Family up to minimum wage	1.29 (0.87-1.92)	1.648	1	0.199
number of household members	0.97 (0.86-1.09)	0.257	1	0.612
Child does not live with either biological parent	1.47 (1.08-2.14)	5.848	1	0.016
Days Absent	1.02 (1.01-1.03)	10.700	1	0.001
Year 2015	1.15 (0.85-1.56)	0.804	1	0.370

Note: CI = confidence interval; df = degrees of freedom.

both sites, children who attended ECE had lower mean EDI scores in Physical well-being, Social competence, and Emotional maturity, with some differences reaching moderate effect sizes. The difference in the remaining domains was only meaningful in Northcity. In 2015, children reported attending an ECE had higher scores than those not attending in all domains in Southcity; while in Northcity children attending ECE had poorer EDI scores in all domains than those reported as not attending.

Discussion

In this descriptive study of two municipalities in the state of São Paulo, Brazil at two different time points (2011 and 2015), we demonstrated that 1) demographics and child development were more similar than different between communities, 2) child development outcomes, measured at school entry with the EDI, were consistently associated with family social economic status, such that children in families with higher socioeconomic disadvantage were more likely to have poorer developmental health, and 3) participation in any ECE program appeared to be associated with developmental outcomes, but in a pattern not consistent across the years of data collection. Most importantly, our analyses also demonstrated that monitoring children's outcomes alone, while useful to assess the state of their development, does not provide enough evidence to assess the causes of changes or impact of any broad measures implemented over time. Many factors play a role in whether interventions and financial supports make a meaningful difference in the lives of young families. While monitoring children's development

Table 7. Demographics and EDI scores for children who attended and did not attend ECE.

(a) Southcity 2011 (n=587).				
Characteristic	**Did not attend any ECE N (%)**	**Attended any ECE N (%)**	**Effect size (Cramer's V)**	**Fisher's exact test p-value**
Male	216 (52.4)	91 (52.0)	<0.01	0.928
Participation in the Bolsa Familia Program	59 (14.5)	297 (11.1)	0.04	0.350
Monthly Income of the Family at a minimum wage	103 (26.2)	26 (15.5)	0.12	0.006
Child lives with at least one biological parents	77 (18.7)	32 (18.3)	<0.001	1.000
Characteristic	**Did not attend any ECE Mean (SD)**	**Attended any ECE Mean (SD)**	**Effect size (Cohen's d)**	**t, df, p-value**
Age (at EDI implementation)	5.44 (0.35)	5.45 0.31)	-0.03	-0.38, 585, 0.701
Days absent from school	6.92 (5.87)	6.97 (8.41)	-0.01	-0.09, 585, 0.464
Number of household members	4.46 (1.35)	4.17 (1.15)	0.23	2.70, 379.47, 0.004
Domain Scores	**Did not attend any ECE Mean (SD)**	**Attended any ECE Mean (SD)**	**Effect size (Cohen's d)**	**t, df, p-value**
Physical health and well-being	9.42 (1.09)	9.38 (1.13)	0.04	0.406, 585,
Social competence	8.71 (1.57)	8.21 (1.74)	0.31	3.266 ,299.79, <0.001
Emotional maturity	8.26 (1.54)	7.61 (1.81)	0.40	4.14, 284.47, <0.001
Language and cognitive development	7.49 (1.83)	7.45 (1.76)	0.02	0.210, 581, 0.834
Communication and general knowledge	8.72 (2.05)	8.89 (1.70)	-0.08	-0.93, 585, 0.350
Vulnerability	**Did not attend any ECE N (%)**	**Attended any ECE N (%)**	**Effect size (Cramer's V)**	**Fisher's exact test p-value**
Physical health and well-being	44 (10.7)	26 (14.3)	0.05	0.211
Social competence	44 (10.7)	32 (18.3)	0.10	0.015
Emotional maturity	35 (8.5)	33 (19.0)	0.15	<0.001
Language and cognitive development	37 (9.1)	16 (9.1)	<0.01	1.000
Communication and general knowledge	47 (11.4)	18 (10.3)	0.02	0.774
Overall Vulnerability	102 (24.8)	60 (34.3)	0.10	0.020
(b) Southcity 2015 (n=132)				
Characteristic	**Did not attend any ECE N (%)**	**Attended any ECE N (%)**	**Effect size (Cramer's V)**	**Fisher's exact test p-value**
Male	22 (59.5)	55 (57.9)	0.01	1.000
Participation in the Bolsa Familia Program	7 (18.9)	20 (21.3)	0.03	1.000
Monthly Income of the Family at a minimum wage	5 (13.9)	14 (15.4)	0.02	1.000
Child lives with at least one biological parents	14 (37.8)	26 (27.4)	0.10	0.293
Characteristic	**Did not attend any ECE Mean (SD)**	**Attended any ECE Mean (SD)**	**Effect size (Cohen's d)**	**t, df, p-value**
Age (at EDI implementation)	5.88 (0.30)	5.87 (0.29)	0.03	0.144, 130, 0.886
Days absent from school	11.04 (7.76)	10.35 (7.00)	0.09	0.492, 130, 0.624
Number of household members	3.31 (1.21)	3.33 (1.07)	-0.02	-0.09, 126, 0.925
Domain Scores	**Did not attend any ECE Mean (SD)**	**Attended any ECE Mean (SD)**	**Effect size (Cohen's d)**	**t, df, p-value**
Physical health and well-being	9.12 (1.30)	9.50 (0.79)	-0.39	-2.00, 46.80, 0.047
Social competence	8.00 (1.81)	8.47 (1.70)	-0.27	-1.40, 130, 0.164
Emotional maturity	7.27 (1.56)	7.80 (1.53)	-0.35	-1.793, 129, 0.075
Language and cognitive development	7.51 (2.16)	7.82 (1.71)	-0.17	-0.79, 54.48, 0.433
Communication and general knowledge	8.19 (2.44)	8.85 (1.79)	-0.33	-1.70, 130, 0.091
Vulnerability	**Did not attend any ECE N (%)**	**Attended any ECE N (%)**	**Effect size (Cramer's V)**	**Fisher's exact test p-value**
Physical health and well-being	6 (16.2)	11 (11.6)	0.06	0.564
Social competence	7 (18.9)	11 (11.6)	0.10	0.272
Emotional maturity	9 (24.3)	9 (9.6)	0.19	0.045
Language and cognitive development	6 (16.2)	8 (8.4)	0.11	0.215
Communication and general knowledge	7 (18.9)	8 (8.4)	0.15	0.124
Overall Vulnerability	12 (32.4)	22 (23.2)	0.10	0.277

Note: N = number; SD = standard deviation; t = t-statistic; df = degrees of freedom.

Table 7. Continued...

(c) Northcity 2011 (n=564)				
Characteristic	**Did not attend any ECE N (%)**	**Attended any ECE N (%)**	**Effect size (Cramer's V)**	**Fisher's exact test p-value**
Male	207 (49.9)	84 (56.4)	0.06	0.182
Participation in the Bolsa Familia Program	62 (15.0)	37 (24.8)	0.11	0.008
Monthly Income of the Family at a minimum wage	60 (17.0)	34 (25.2)	0.09	0.050
Child lives with at least one biological parents	78 (18.8)	42 (28.2)	0.10	0.020
Characteristic	**Did not attend any ECE Mean (SD)**	**Attended any ECE Mean (SD)**	**Effect size (Cohen's d)**	**t, df, p-value**
Age (at EDI implementation)	5.37 (0.31)	5.29 (0.25)	0.24	2.82, 316.559, 0.005
Days absent from school	7.92 (11.27)	7.84 (7.47)	0.01	0.09, 562, 0.929
Number of household members	4.01 (1.07)	3.89 (1.16)	-0.08	1.078, 245.947, 0.282
Domain Scores	**Did not attend any ECE Mean (SD)**	**Attended any ECE Mean (SD)**	**Effect size (Cohen's d)**	**t, df, p-value**
Physical health and well-being	9.61 (0.86)	9.38 (0.94)	0.26	2.75, 241.212, 0.009
Social competence	9.17 (1.23)	8.78 (1.41)	0.31	3.00, 233.032, 0.003
Emotional maturity	8.54 (1.28)	8.02 (1.81)	0.37	3.281, 204.040, 0.001
Language and cognitive development	7.39 (1.91)	7.59 (1.72)	-0.10	-1.10, 561, 0.273
Communication and general knowledge	9.16 (1.55)	9.27 (1.09)	-0.08	-0.941, 373.706, 0.348
Vulnerability	**Did not attend any ECE N (%)**	**Attended any ECE N (%)**	**Effect size (Cramer's V)**	**Fisher's exact test p-value**
Physical health and well-being	28 (6.7)	18 (12.1)	0.09	0.05
Social competence	20 (4.8)	15 (10.1)	0.10	0.029
Emotional maturity	13 (3.1)	21 (14.1)	0.20	<0.001
Language and cognitive development	47 (11.4)	11 (7.4)	0.06	0.209
Communication and general knowledge	20 (4.8)	3 (2.0)	0.06	0.156
Overall Vulnerability	75 (18.1)	46 (30.9)	0.137	0.002
(d) Northcity 2015 (n=411)				
Characteristic	**Did not attend any ECE N (%)**	**Attended any ECE N (%)**	**Effect size (Cohen's d or Cramer's V)**	**t, df, p-value OR Fisher's exact test p-value**
Male	55 (55.0)	159 (51.1)	0.09	0.565
Participation in the Bolsa Familia Program	10 (10.0)	72 (24.0)	0.15	0.002
Monthly Income of the Family at a minimum wage	15 (15.5)	92 (30.9)	0.15	0.003
Child lives with at least one biological parents	25 (25.3)	107 (34.4)	0.08	0.108
Characteristic	**Did not attend any ECE Mean (SD)**	**Attended any ECE Mean (SD)**	**Effect size (Cohen's d)**	**t, df, p-value**
Age (at EDI implementation)	5.88 (0.30)	5.89 (0.30)	-0.04	-0.38, 409, 0.703
Days absent from school	14.62 (11.66)	12.56 (10.80)	0.19	1.63, 409, 0.103
Number of household members	2.92 (1.08)	3.09 (1.25)	-0.14	-1.23, 404, 0.219
Domain Scores	**Did not attend any ECE Mean (SD)**	**Attended any ECE Mean (SD)**	**Effect size (Cohen's d)**	**t, df, p-value**
Physical health and well-being	9.55 (0.94)	9.31 (1.11)	0.22	2.13, 196.649, 0.034
Social competence	8.68 (1.59)	8.41 (1.68)	0.16	1.44, 409, 0.151
Emotional maturity	7.90 (1.39)	7.69 (1.66)	0.13	1.25, 197.298, 0.213
Language and cognitive development	7.78 (1.80)	7.60 (1.83)	0.10	0.88, 408, 0.380
Communication and general knowledge	8.72 (1.86)	8.58 (2.01)	0.07	0.61, 409, 0.542
Vulnerability	**Did not attend any ECE N (%)**	**Attended any ECE N (%)**	**Effect size (Cramer's V)**	**Fisher's exact test p-value**
Physical health and well-being	8 (8.0)	41 (13.2)	0.07	0.214
Social competence	14 (14.0)	47 (15.1)	0.01	0.872
Emotional maturity	8 (8.0)	43 (13.8)	0.08	0.162
Language and cognitive development	9 (9.0)	25 (8.1)	0.01	0.836
Communication and general knowledge	10 (10.0)	36 (11.6)	0.02	0.720
Overall Vulnerability	21 (21.0)	97 (31.2)	0.10	0.057

Note: N = number; SD = standard deviation; t = t-statistic; df = degrees of freedom.

is important, it only tells us what is happening, not why it is happening. Future studies should examine sociodemographic variables of the children and their families (e.g. income, employment, education, and marital status of parents, living arrangements, number of people living in the household, size of town/city where they live), as well as program-specific ones, such as indicators of quality (e.g. training/experience of educators, quality of the curriculum, instructional practices and delivery), to help better interpret the developmental outcomes of the children.

Two of the consistent differences in sample composition between the 2011 and 2015 implementations in both municipalities, children's older age and more school days missed in 2015, were a consequence of the administration of the EDI happening later in the school year – thus, by definition, children were older and had a chance to miss more school days. There were some notable changes over time, however. In both municipalities, the number of people in the family declined over time. Participation in Bolsa Familia program increased in both municipalities percentage-wise, but was only statistically significant (with a small effect size) in Southcity. Moreover, the percentage of families earning minimal wage decreased in Southcity but grew in Northcity.

In terms of child development, with the exception of the language and cognitive development domain, where mean scores improved slightly between EDI implementations, children in 2015 had poorer scores and higher vulnerability in most domains than in 2011. While at first glance this may seem as though the program was making things worse for the children, when we explored the contribution of sociodemographic factors on children's outcomes, we found that being male and participation in the Bolsa Familia program (an indicator of poverty) were consistent predictors of child vulnerability, and there was a greater percentage of children in 2015 who were participating in the Bolsa Familia program compared to 2011. These associations are highly consistent with findings from other countries (Cushon et al., 2011; Eamon, 2001; Hamad & Rehkopf, 2016; Martinez et al., 2017). Our measure of low income was only a significant contributor in Southcity, but not in Northcity, suggesting that maybe in some regions, the official income levels are not the best indicators of actual disadvantage (e.g., where there may be a thriving "underground" economy). Another difference between municipalities was that not living with both biological parents was associated with children's developmental vulnerability in Northcity only. One possibility for this difference is that the proportion of children not living with both parents was smaller in Southcity to start with, so there may not have been enough power to detect an association. The other possibility is that the supports for single-parent families in Southcity were better than those in Northcity, which may have offset the potential disadvantage of living in a single-parent household. This is purely speculative at this point as given the data at hand, we are unable to determine whether that was indeed the case. A notable, and actionable, finding was that missing school days contributed negatively to children's overall vulnerability on the EDI. Similar phenomenon was observed in Ontario, Canada (Davies et al., 2016). This can be easily translated into a recommendation for education systems to pay attention to the progress of children who appear to miss school days and ensure that they are well supported.

While we are also unable to make any determination of causal influences on participation in ECE programs on child development in our samples, the descriptive analyses revealed a pattern change between the two times. First of all, with the exception of a smaller percentage of children from families with low income in 2015 than in 2011 in Southcity, there were no differences in the demographics of children reported to attend and not attend ECE. Second, in 2011, in both sites, children reported to have attended ECE had poorer developmental scores on the EDI, compared to their peers who had not attended. This relationship remained the same at both time points in one site, Northcity, where children with ECE participation had poorer scores than those without. Interestingly, the small advantage these children had in the language/cognitive and communication domains in 2011 disappeared in 2015. In contrast, in Southcity, the relationship reversed in the 2015 EDI implementation, where children who participated in ECE had better developmental scores than those who did not, perhaps suggesting that there was a positive influence of early learning programs. While we cannot be certain, one possibility is that the socioeconomic circumstances and supports,

possibly including the quality of early childhood programs, have improved over the four years in Southcity, but not in Northcity. Considering the lack of additional, crucial variables, and many missing responses, this possibility is highly speculative at this time. The authors of this report believe that additional qualitative data were collected by FMCSV from the communities, at least in the first years of the project. However, they were a separate component of the project, and the authors did not have access to them, which is an important limitation. While this information could have contributed to the explanation of the differences between municipalities, it is also possible that it might not have, as the intervention was a broad, systemic one. Nevertheless, the current study cannot address the question of whether the quality of implementation may have influenced the outcomes.

Strengths and limitations

Our study has several strengths – municipality-level implementation, comprehensive assessment of child development, inclusion of key sociodemographic variables – which allowed us to establish the association between indicators of disadvantage and children's development at school entry. However, the limitations of this work are very stark in particular when we consider the impact of ECE. For one, there was a lot of missing data on this variable. It is therefore possible our findings would have differed had we had more data on ECE attendance. Furthermore, as indicated above, another limitation of the study is a lack of information on how the FMCSV's program was implemented in each city, including program quality, which could have provided us with more insight into the developmental outcomes observed in our sample.

Conclusion

In this descriptive study of two Brazilian municipalities at two time points, we demonstrated that there were many similarities in children's demographics and development between communities, that child development outcomes were associated with family socioeconomic conditions, and that participation in an ECE program was inconsistently associated with developmental outcomes. Our study also revealed that monitoring children's outcomes alone does not offer enough evidence to assess the causes of changes in children's development or to evaluate the impact of any broad measures implemented over time. The lesson for monitoring the progress towards meeting the goals of SDG4 is that, in order to understand what makes a difference in children's well-being, both child development and policy environment have to be monitored globally. Moreover, we also recommend that evaluation designs combine implementation and outcome measures at both monitoring and analytic levels to facilitate the understanding of program impact(s).

Financial support

None

Conflict of interest

None

Acknowledgements

None

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