International Initiative for Impact Evaluation
Systematic Review 007

The impact of daycare programs on child health, nutrition and development in developing countries: a systematic review

Jef L Leroy, Paola Gadsden and Maite Guijarro

September 2011

THE IMPACT OF DAYCARE PROGRAMS ON CHILD HEALTH, NUTRITION AND DEVELOPMENT IN DEVELOPING COUNTRIES: A SYSTEMATIC REVIEW

Jef L Leroy, International Food Policy Research Institute, Washington DC
Paola Gadsden, Instituto Nacional de Salud Pública, México
Maite Guijarro, Centro de Investigación y Docencia Económicas, México

Corresponding author:
Jef L Leroy
j.leroy@cgiar.org

About 3ie

The International Initiative for Impact Evaluation (3ie) works to improve the lives of people in the developing world by supporting the production and use of evidence on what works, when, why and for how much. 3ie is a new initiative that responds to demands for better evidence, and will enhance development effectiveness by promoting better informed policies. 3ie finances high-quality impact evaluations and campaigns to inform better programme and policy design in developing countries.

3ie Systematic Reviews examine the range of available evidence regarding a particular intervention. 3ie is partnering with the Campbell Collaboration (C2) in the production of systematic reviews. All reviews will be registered with C2, and the protocols and reviews submitted to C2. 3ie's approach is also influenced by the realist perspective, which stresses the importance to recognizing how outcomes may vary by context.

Photographs: Jef L Leroy, Mexico, Istockphoto, Crestock

Content

Acknowledgements

This review was supported by the International Initiative for Impact Evaluation (3ie). We are grateful to Hugh Waddington and to the anonymous reviewers who provided invaluable comments and suggestions. The authors are responsible for all the remaining errors.

Summary

Urbanization and increases in female labor market participation have increased the demand for non-parental childcare in many low and middle-income countries. Especially in formal sector jobs, work and caring for one's child cannot be combined. Government daycare programs currently under way in several developing countries seek to promote labor force participation through relieving one of the most pressing constraints faced by working parents, especially mothers, i.e. access to reliable and affordable childcare. Whilst there are a number of impact evaluations of day care interventions in developing countries, no systematic review of the literature has been conducted.

We conducted a systematic review of impact evaluations examining the impact of daycare interventions on the health, nutrition and development of children under five years of age in low- and middle-income countries. The second objective was to use a program impact theory approach to identify the pathways through which daycare may improve child outcomes. The third and final objective was to review the available information on the demand for daycare services.

The review was restricted to intervention studies (defined as studies evaluating the impact of an exogenous change in daycare provision or utilization on child outcomes) using experimental or quasi-experimental methods (e.g. propensity score matching), as well as regression-based methods to control for potential self-selection of program participation. A comprehensive and systematic search of the unpublished and published literature dating back to 1980 was conducted. No language restrictions were imposed. Papers were excluded based on study scope, type and quality.

Only 6 studies (all conducted in Latin America) met our inclusion criteria. In general, large positive effects on measures of short and longer term child development were found. Due to inconsistent results, no conclusions can be drawn with respect to the impact on child health and nutrition. More rigorously conducted studies on the impact of daycare programs in low and middle income countries are needed. These should be conducted in a variety of settings and provide a clear description of the counterfactual care scenarios. Intermediary variables that help explain the pathways of impact need to be measured and taken into account in the analyses.

1. Introduction and background

Many women in developing countries face the difficult challenge of competing demands on their time. Women are often in charge of activities related to child rearing and other time-intensive domestic activities such as collecting fuel-wood and fetching water. Additionally, they engage in nondomestic production activities, such as formal and informal labor market activities and agricultural work, resulting in high workloads (Engle et al., 1997). The situation of mothers has been coined as a zero-sum game: a new activity can only be added if she drops another activity or becomes more efficient in it (McGuire, 1989).

Many hypothesize that the higher unemployment rates and fewer working hours for females, as compared to their male counterparts, are –at least partly– due to those conflicting demands on women's time (Ruel et al., 2007). Urbanisation and increases in female labor market participation have increased the demand for non-parental childcare in many low and middle-income countries. Especially in formal sector jobs, work and caring for one's child cannot be combined. Government daycare programs currently under way in several developing countries seek to promote labor force participation through relieving one of the most pressing constraints faced by working parents, especially mothers, i.e. access to reliable and affordable childcare.

The effects of maternal labor market participation and its effect on the child have been studied widely. Most studies focus on the trade-off between the potential positive effects of increased income earned by the mother and the negative effect of the decrease in time available for childcare. This model, however, ignores several important issues. First, there is the self selection of women that decide (not) to work; second, contrasting working with non-working is a simplification, since working conditions may differ considerably relative to providing childcare; finally, the availability and quality of alternative childcare is an important variable as well (Engle and Pedersen, 1989).

Zoritch et al (2000) conducted a systematic review of randomized and quasi-randomized controlled trials on the effect of daycare on children. The review was limited to studies conducted in the US. Based on 8 published trials, the authors concluded that daycare had positive effects on child development and mothers' interaction with their children. Few studies looked at health outcomes. The authors emphasized the urgent need for higher quality studies in this area. No systematic review of the evidence from studies in low and middle income countries has been conducted. The aim of this review was to fill in this gap in the literature.

The remainder of the report is structured as follows. Section 2 presents the objectives of the review. A theoretical model is presented in Section 3. Section 4 and 5 follow with the methodology and the results. Section 6 concludes with the discussion and final conclusions.

2. Objective and scope

The first objective of this study was to conduct a systematic review of the impact of daycare on the health, nutrition and development of children under 5 years of age in low and middle income countries. Daycare is defined as any type of institutional out-of-home care for children younger than 5 years of age, independent from who provided the daycare (government, private or a combination of both). Daycare can range from a service just providing a safe place where children are taken care of while their mothers work, to preschool services that offer health, nutrition and education components. Three types of outcomes were studied: child health (including common childhood illnesses such as diarrhea and acute respiratory infections), child nutrition (child anthropometry, child anemia, child dietary intake, etc) and child development (including psychomotor, sensory, language, cognitive and social-emotional development). Our second objective was to use a program impact theory approach to identify the pathways through which daycare may improve child outcomes. Program impact theory refers to the pathways that connect a program's activities to its intended outcomes (Rossi et al., 2004). Finally, we reviewed the available information on the demand for daycare services.

It is important to note that the focus of our review is different from that of a number of recent reviews on early childhood development (ECD) interventions (Engle et al., 2007; Nores and Barnett, 2010; Baker-Henningham and Lopez-Boo, 2010). The objective of ECD interventions is to promote child development through a variety of activities, such as improving nutritional status and health, reducing the social, environmental and infectious risks children are exposed to and providing cognitive and socio-emotional stimulation. ECD interventions can be offered in different settings, including home-based, center-based, formal preschool, and parent/community-based arrangements. The interventions we review here may or may not have specific ECD components in place. Common to all of them, however, is that they provide formal out-of-home care for children under the age of five which allows parents to participate in the labor market.

3. Intervention and theoretical model

Providing women with accessible and affordable daycare might affect child nutrition, health and development through a number of different mechanisms. The program theory presented in **Figure 1** is based on Ruel's framework (Ruel, 2008). While the framework refers explicitly to the mother as the primary care giver, it is applicable to cases where the primary caregiver is another household member. Maternal employment may increase household income, which might increase household food security and allow households to purchase better (i.e. more nutrient dense) and more foods. This, in turn, could lead to improved child dietary intake. Maternal employment may also increase women's control over income and their decision making power with respect to child feeding and health. The meals provided to children while attending daycare may directly – either positively or negatively - affect the adequacy of child dietary intake. The hygiene and sanitation levels of the daycare attended might lead to changes in childhood illness, especially infectious diseases. Additionally, daycare may increase the risk of exposure to communicable diseases through contact between children. Daycare safety determines the odds of accidents and consequently child health. The potential impacts on child development depend – in part - on the quality of the educational activities provided. Social interaction may have a positive impact on child development as well, but may also lead to more exposure to communicable diseases. Maternal employment may have a negative effect on women's time, which, in turn, might limit her ability to provide adequate care. Finally, the services provided at daycare might affect the level of care provided at home. For instance, the food offered to children in daycare might cause parents to offer less (or lower quality) foods to children at home (i.e. substitution). Daycare might have similar effects on the level of hygiene, sanitation and child stimulation provided at home. For instance, parents may consider the amount of stimulation their children receive in daycare to be sufficient and hence reduce or even stop engaging in these types of activities at home. Alternatively, parents might learn from the services provided at daycare and improve the care environment and practices at home.

The potential impact a daycare program might have is ultimately determined by the difference between the quality of care provided in the daycare setting and the quality of alternative forms of care children (would) receive in the absence of daycare. If daycare interventions provide a high quality alternative to working mothers who would otherwise take their young children to work, a positive impact on child outcomes can be expected. On the other hand, a program that pulls children from high quality care in the family setting to low quality daycare may have negative effects on children.

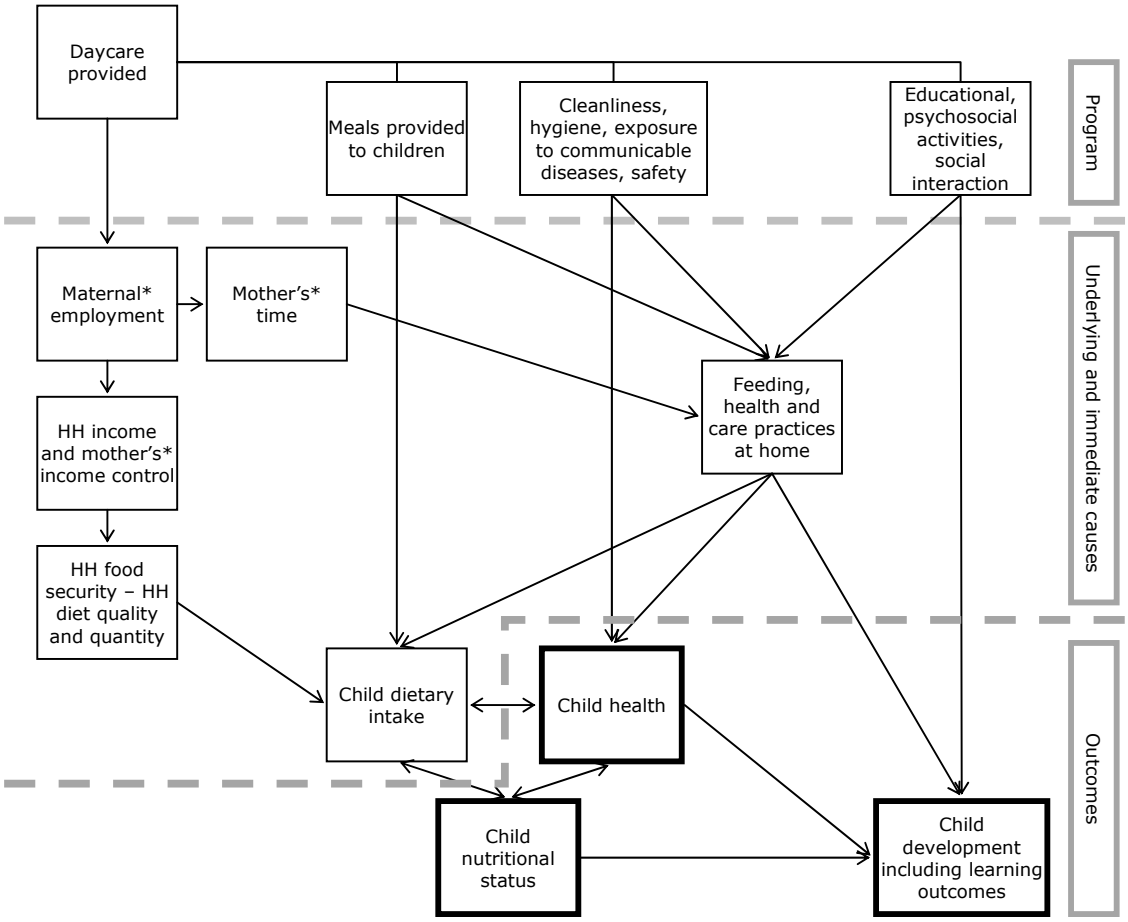


Figure 1: Mechanisms by which daycare programs might affect child nutritional status, health and development

*Even though we refer to mothers, the primary caregiver of the child may also be older siblings or other family members.

4. Methods

Inclusion and Exclusion Criteria

The studies selected for our review included intervention studies (defined as studies evaluating the impact of an exogenous change in daycare provision or utilization on child outcomes) using quasi-experimental methods (e.g. propensity score matching), as well as regression-based methods to control for potential self-selection (endogeneity) of program participation.

We limited the review to papers published after 1980. No language restrictions were imposed. The selection of articles for full review from the pool obtained during the database searches was conducted in three phases, with increasing specificity. Papers were excluded based on study scope, type and quality (see **Table 1**). We first scanned the title to exclude studies that were out of the scope of the review (see below). We then read the abstract and excluded papers not meeting the criteria for study scope, type and quality. To avoid incorrectly excluding studies that met the inclusion criteria, we erred on the side of caution: when in doubt we always decided to review the full text. The searches were conducted in parallel by two researchers, that is, two authors independently reviewed all identified titles and abstracts. The full text review was also conducted independently by both authors. Any disputes were resolved by a third author.

Table 1 Overview of exclusion criteria

Exclusion criterion	Study excluded if…
Study *scope*	(a) Study did NOT evaluate the impact of a daycare intervention on child health, nutrition or development, comparing (groups of) children receiving this intervention with (groups of) children not receiving it. (b) Study's main focus was on disabled children, orphans, children living with HIV/AIDS, child abuse, malnourished children, etc. (c) Study only described the situation in daycare centers or the quality of services provided.
Study *type*[#]	(a) Editorial, commentary or book review. (b) Policy document. (c) Survey solely reporting the prevalence or incidence of the use of daycare centers or the prevalence or incidence of diseases, malnutrition, dietary patterns of children attending daycare centers. (d) Non-evaluated intervention. (e) Theoretical or methodological study. (f) Single-case study. (g) Study that only evaluated the process of an intervention.
Study *quality*	(a) Study that did NOT provide sufficient details about: • the intervention (including setting, beneficiary population, benefits). • sample characteristics (age, sample size). • study type and analytic model; statistical tests on the studied associations; coefficients and level of significance reported numerically or graphically. • detailed description of the methodology used to control for confounding and selection bias, i.e. providing details on the instruments used in case of IV estimation or the variables used for matching in case of (propensity) matching. (b) Study only used univariate methods for data analysis.

[#]Adjusted from Shepherd et al. (1999)

Data sources and search strategies

Our primary searches were conducted in two academic databases, PubMed and EconLit, using a wide range of terms intended to maximize the number of potentially relevant articles identified. In addition, we searched a number of databases including grey literature (IDEAS, POPLINE, the British Library for Development Studies (BLDS) and Literatura Latinoamericana y del Caribe en Ciencias de la Salud (LILACS)) and the websites of the World Bank (including the JOLIS catalog) and the International Food Policy Research Institute (IFPRI). We finally added papers suggested by colleagues and international experts in the field, as well as papers identified through reviewing the reference list of non systematic reviews.

The search strategy combined a group of 'exposure' terms (representing the daycare programs), with 'outcome' terms (child health, nutrition and development), 'subject' terms

(children) and 'context' terms (developing countries) (see **Table 2**). In the final search syntax, exposure terms were combined with the outcome, subject and context terms by the Boolean operator "AND" (i.e. 'exposure terms' AND 'outcome terms' AND 'context terms'). Search terms within these four domains were connected by the Boolean operator "OR". The final search strings used for each database are listed in **Appendix A**. Where spellings differed between British and American English, we searched for both.

The terms mentioned above were used within each of the databases to identify relevant indexing terms to be included in the database specific search phrase. EconLit was searched using OCLC and PubMed using NCBI. Relevant medical subject heading (MeSH) terms were identified and included in the PubMed search phrases. Website searches were limited to "exposure" terms due to limitations in the available search engines.

A number of complementary strategies were used to identify additional studies. We conducted citation tracking (back and forward referencing of the selected studies) in Google Scholar and Web of Science; we hand-searched the journals[1] (and websites) where the selected studies were published (i.e. Journal of Public Economics, the Review of Economics and Statistics, and the websites of Institute of Fiscal Studies, IFPRI and the Centro de Estudios sobre Desarrollo Económico of Universidad de los Andes in Colombia). Since the oldest selected study was published in 2004, these hand searches were limited to papers published after 1999. A regular Google search (limited to the first 500 hits) was conducted as well. Finally, we contacted international leading experts and the authors of the selected papers regarding published or unpublished work relevant for this review.

To strengthen the pathway analyses, we searched for "sister studies" (i.e. process evaluations, qualitative studies, etc.) of the selected impact evaluations. To identify these studies, we contacted the authors of the selected papers and conducted a regular Google search (limited to the first 50 hits sorted by relevance) using the name of the program as a search term. The objective of this search was to obtain complementary information on the characteristics of the evaluated programs and their beneficiaries and to identify any other information relevant for the pathway analysis.

[1] Hand searching of the journals was done online.

Table 2 Overview of search terms

Domain	***Description***	**Search terms***
Exposure	*Intervention*	Child daycare centers, child care, infant care, child daycare, nursery*, nursery school*, pre-school*, kindergarten
Outcome	*Health*	Health, infection*, disease*, morbidity, diarrhea, diarrhoea
	Nutrition	Diet, nutrition, growth, height, weight, anemia, stunting, wasting, deficiency* nutrient*
	Development	Intelligence, infant development, child development, psychomotor, motor, sensory, language, social, emotional, cognitive, cognition
Subjects	*Children*	Child, children, preschool child, preschool children, infant*
Context	*Low and middle income countries*	Developing country*, third world country*, low income country*, middle income country*, developing nation*, Afghanistan, Albania, Algeria, Samoa, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Belarus, Belize, Benin, Bhutan, Bolivia, Bosnia, Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Volta, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Zaire, Costa Rica, Côte d'Ivoire, Ivory Coast, Croatia, Cuba, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guyana, Haiti, Honduras, India, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Korea, Kyrgyz Republic, Kyrgyzstan, Lao, Latvia, Lebanon, Lesotho, Liberia, Libya, Lithuania, Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Mauritania, Mauritius, Mayotte, Mexico, Micronesia, Moldova, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Romania, Russia, Russian, Rwanda, Samoa, São Tomé, Principe, Senegal, Serbia, Seychelles, Sierra Leone, Solomon Islands, Somalia, South Africa, Sri Lanka, Kitts, Nevis, Lucia, Vincent, Grenadines, Sudan, Suriname, Swaziland, Syrian Arab Republic, Syria, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tonga, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, Uruguay, Uzbekistan, Vanuatu , Venezuela, Vietnam, West Bank, Gaza, Yemen, Zambia, Zimbabwe

* Refers to the same word in plural.

Data collection and coding

The studies that met the inclusion criteria were reviewed in depth. The characteristics of the articles were described and their results were tabulated. Data were summarized into the following categories: country, intervention (including the eligibility criteria), sample characteristics (data sources and years, age of the children, sample size), evaluation design

and analytic method (definition of treatment, outcomes, analyses), study quality assessment and results by outcome (health, nutrition and development).

We first reviewed the impact on the variables of interest, i.e. child nutrition, health and development. We then used a "program theory" approach to identify the pathways through which daycare may improve child outcomes (see **Figure 1**). Program theory refers to defining the pathways by which a program is intended to achieve its impacts (Rossi et al., 2004). Identifying these pathways allows for the best understanding of whether, why, and how a program achieved, or did not achieve, its intended impacts. Finally, we reviewed the available information on the demand for daycare services.

IRB review

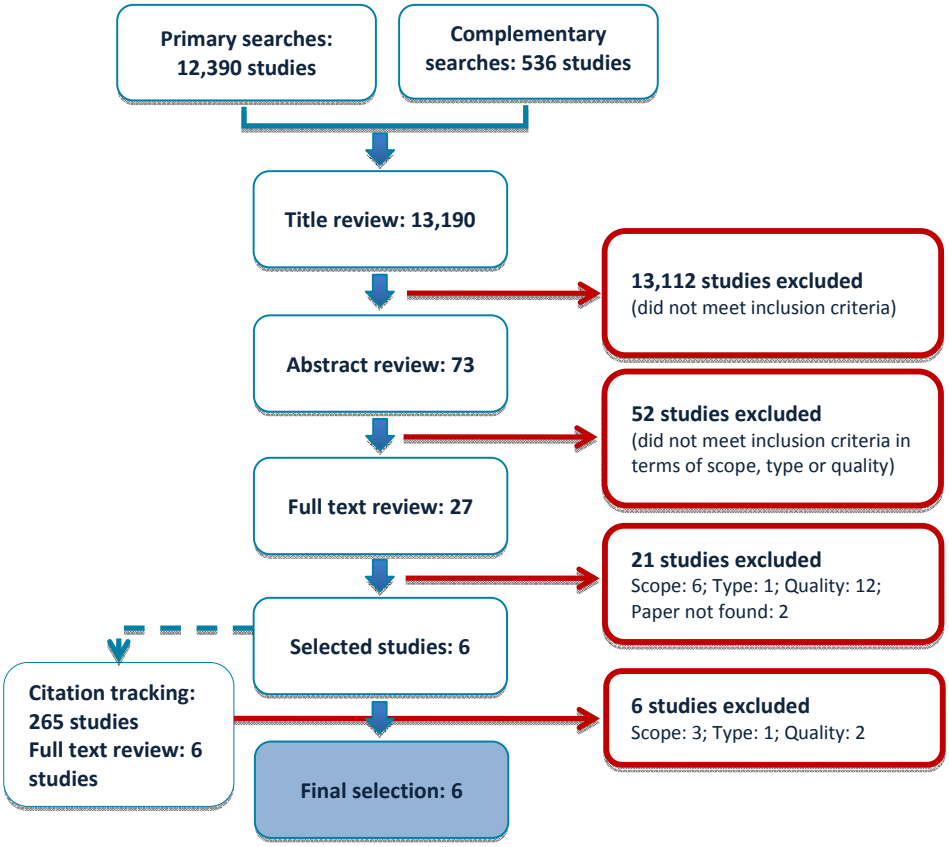
The study protocol was reviewed by the ethics and research boards of the National Institute of Public Health in Mexico (Federal Wide Assurance FWA00000344).

5. Results

Study selection

A total of 12,390 papers were identified through our database searches (**Figure 2**). Selection based on a review of the study titles resulted in a total of 49 articles. An additional 24 studies (out of 536) were identified through hand searches of relevant journals, searches of websites, Google searches, reviews of reference lists of non systematic reviews or suggestions by colleagues (see **Appendix A** for detailed search results by source). After reviewing the abstracts of the 73 studies, 27 articles were selected for a full text in-depth review. Of those, an additional 21 studies were excluded because they did not meet the inclusion criteria (**Appendix B**). From the back and forward citation tracking of the selected studies, 6 additional studies were identified for review, but none met the inclusion criteria. As such, only 6 studies were included in the review.

Figure 2 Study selection process



Summary of the studies included in the review

As shown in **Tables 3.1** to **3.3**, all studies evaluated the impact of programs in Latin-American countries. Three of the interventions (Colombia, Bolivia and Guatemala) used a

community based approach in which women from the community provided daycare in their homes. The programs in Argentina and Uruguay used an institutional approach through the provision of preschool education. The studies are described in more detail below. **Appendix C** provides detailed summary tables of the included studies.

Community based interventions – Attanasio et al. (2010) assessed the impact of the *Hogares Comunitarios de Bienestar* (HCB) program in Colombia. HCB is targeted at children under the age of 6 and provides, for a small fee, daycare and food (70% of nutrient requirements) at the house of a *madre comunitaria*. The authors estimated the impact of the program on the nutritional status of children under 6 using different data sets for rural and urban areas. Three rounds of panel data (2002, 2003, 2005-6) collected for the evaluation of the *Familias en Acción* (FeA) program (a conditional cash transfer program) were used for the HCB evaluation in rural areas. Only data from FeA control areas were used. It is not clear how the authors dealt with the three rounds of data in the model. The evaluation in urban areas used data from the Colombian version of the Demographic and Health Survey. Instrumental variable regression was used to estimate the program's impact. The distance of the household to the nearest HCB, the median fee paid by children who attended a HCB in the locality, and the number of HCB places available in a given municipality relative to the eligible population were used as instruments in the rural sample. In the urban sample, only the last instrument (capacity) was used. The authors estimated the overall impact and the impact by quintiles of child height (Attanasio et al., 2010).

Bernal et al. (2009) assessed the impact of the same HCB program in Colombia using cross-sectional data collected in 2007. The authors estimated the impact on child nutrition (child stunting, underweight and wasting), child health (the prevalence of diarrhea and respiratory illness, complete vaccination) and child development (cognitive and psychosocial outcomes). In addition, they measured the medium term impact of the program on test scores of children in 5th grade. Program impact was estimated using propensity score matching (kernel) with three different comparisons: treatment vs. control, children exposed for <1, 2-4, 5-15 and over 16 months *vs.* control and children exposed ≤ 1 month *vs.* 2-4, 5-15 and over 16 months. They also estimated the effect by a number of HCB and *madre comunitaria* characteristics: whether the daycare center provided full or part time daycare, whether the center had dirt or cement floors, whether they received additional funding, whether the *madre comunitaria* had more than 12 years of schooling and whether she had received the program's nutrition training.[2] For the medium term outcomes, the authors used an instrumental variables estimation approach using the availability of places in HCB at the municipality level per 1000 poor inhabitants as an instrument (Bernal et al., 2009; Universidad de los Andes and Profamilia, 2009).

The impact of the Bolivian *Programa Integral de Desarrollo Infantil* (PIDI) on the nutritional status and development (bulk motor, fine motor, language and auditory, and psycho-social skills) of children between the age of 6 and 72 months was estimated by Behrman et al. (2004). PIDI provides fully subsidized daycare to children between 6 and 72 months. Services are provided in the homes of women in low-income areas and include food (70% of nutrient requirements) as well as health and nutrition monitoring and educational activities. The authors pooled two cross-sectional data sets including information on children participating in the program and children in two comparison groups: non-participating children living close to PIDI homes and children in poor urban areas not served by the

[2] The results strongly indicate that the impact estimates using the control group as the counterfactual suffer from selection bias. This was confirmed by the author (personal communication with Raquel Bernal, December 2010). We only report and discuss the results obtained from the estimations using the <1 *vs.* >1 month exposure comparison.

program. PIDI children were matched to eligible children in the two comparison groups. Behrman and colleagues estimated the impact of attending the program (comparing treated children to children in the two comparison groups) and the marginal program impact (comparing children who had been in the program for 2 or more months with children who had been in PIDI for 1 month or less). The program impact was estimated by child age and by duration of time in the program (Behrman et al., 2004).

Ruel et al. (2006) assessed the impact of Guatemala's *Hogares Comunitarios* (HC) program on dietary intake of children between the age of 2 and 5 years. HC services include full-time daycare provided by women in the community, food (80% of nutrient requirements), psycho-pedagogical activities and general care and hygiene. Two estimation strategies were used: matching by design (at the time of subject selection) and propensity score matching (nearest neighbor and kernel) (Ruel et al., 2006).

Institutional daycare - Berlinski et al. (2009) evaluated the impact of the expansion of public pre-primary provision (through the construction of 3724 preschool classrooms) in Argentina from 1993-1999 on mathematics and Spanish test scores and student behavior (as perceived by the teacher) in 3rd graders. The authors pooled subsequent rounds of cross-sectional data from the Argentine household surveys (rounds 1994 to 2000) and used the exogenous increase in preschool availability as the treatment variable. Berlinski and colleagues evaluated whether the impact was different for boys and girls and whether it was modified by the municipality specific poverty level (G. Berlinski et al., 2009).

The second study by Berlinski et al. (2008) evaluated the impact of the expansion of public preschool services (through classroom construction) in Uruguay on school attendance and years of schooling of children between the age of 7 and 15 years. The authors pooled rounds 2001 to 2005 of the *Encuesta Continua de Hogares*, which included retrospective information on years of preschool education. The authors used a within household estimator, which took advantage of the variability between siblings to estimate the impact of preschool on later school performance. In addition, they instrumented preschool attendance with average locality and cohort-specific attendance rates to estimate the impact of the program. Berlinski and colleagues estimated the overall impact, the impact by additional years of preschool attended and the impact by child sex, maternal schooling and by location (living in Montevideo *vs.* outside of city) (Berlinski et al., 2008).

Effectiveness results

Impact on child health (see **Table 3.1) –** The only study including child health outcomes was the second evaluation of the Colombia program. Significant reductions in the prevalence of diarrhea and acute respiratory infections (ARIs) were found for children with longer exposures to the program: the program reduced the prevalence of diarrhea by 6.9 percentage points (95% CI: -12.8, -1.0) among children between 0 and 24 months with more than 16 months of exposure; 4.2 (-8.1, -0.3) and 6.8 percentage points (-10.7, -2.9) for children between 25 and 36 months with 5 to 15 months and more than 16 months of exposure respectively; and 4.2% (-4.6, -3.8) for children above 49 months with more than 16 months of exposure. No effect was found for the other age/exposure combinations. In addition, the program reduced the prevalence of ARI by 3.4 (-3.6, -3.2) and 3 percentage points (-5,-1) for children with 16 months of exposure and who were 0 to 24 months and 25 to 36 months respectively. No ARI effect was found in the other age-exposure groups. Note that the estimated diarrhea and ARI effects can be explained in two different ways. They could represent a true positive health effect of the program. Alternatively, the children who just entered the program (i.e. with less than one month of exposure) and who served as the comparison group for these analyses might have suffered from a steep increase in diarrheal

and respiratory infections right after entering daycare. As children stayed in the program longer, this negative effect might have slowly disappeared which would explain the positive program effect in the older age groups. Finally, the impact on the proportion of children who were completely immunized was unclear: a negative impact of 3.9 percentage points (-7.9, 0.0) was found for children between the age of 0 and 24 months who had been in the program for more than 16 months and a negative impact of 2.9 percentage points (0.9, 4.9) among children between 25 and 36 months with the same exposure. No effect was found for the other age-exposure combinations (Bernal et al., 2009; Universidad de los Andes and Profamilia, 2009).

Impact on child nutrition (see **Table 3.2)** - Three studies (Colombia (Universidad de los Andes and Profamilia, 2009; Attanasio et al., 2010) and Bolivia (Behrman et al., 2004)) estimated the impact on child anthropometry. Current attendance at daycare in Colombia assessed by Attanasio et al. (2010) had an estimated impact of 0.448 SD (95% CI: 0.076, 0.820) on the HAZ of children between the age of 0 and 6 years in rural areas and 0.826 SD (0.450, 1.202) in urban areas. Full exposure (i.e. a –hypothetical- child that spent the first 72 months of its life in a HCB) was estimated to have an effect on child HAZ of 0.945 SD (0.228, 1.662) in rural areas and 1.227SD (0.512, 1.942) in urban areas. When estimating the effects by child height quintiles, the authors found larger effects for shorter children. The impact estimates in this study are biologically implausible. They are considerably larger than the effects of interventions specifically aimed at improving child growth. Additionally, the average age of children in the study was 49 and 36 months for the rural and urban samples respectively. It is well known that the growth effect of nutrition interventions is mostly limited to children younger than 24 months (see for instance Schroeder et al.,1995). Finally, the exposure variable (defined as the proportion of the child's life spent in daycare) is difficult to interpret. It is unlikely that the effect of daycare on child growth is linear with respect to the proportion of the child's life spent in daycare, rather than with the absolute amount of time (Attanasio et al., 2010). The second evaluation of the same program found no consistent nutrition effect. A significant 6.3 percentage point (95% CI: 2.4,10.2) increase in stunting was found in children who were 0 to 24 months old with 2 to 4 months of exposure to the program, but no significant stunting effects were found in the eleven other age-exposure combinations. It is very unlikely that the program had such an impact on the height of children within a matter of months. The prevalence of being underweight dropped by 2.6 percentage points (95% CI: -4.6, -0.6) among children between 25 and 36 months with 5 to 15 months of exposure to the program and by 2.1 percentage points (-4.1, -0.1) for children between 37 and 48 months with 2 to 4 months of exposure. For the other age-exposure combinations, no impact was found. The prevalence of wasting did not change as a consequence of the program (Bernal et al., 2009; Universidad de los Andes and Profamilia, 2009).

No program impact on growth was found in Bolivia (Behrman et al., 2004). When comparing participating children to eligible children in areas not served by the program, a negative impact (7 to 9 percentage points)[3] on weight-for-age was found for short program exposure (less than 12 months). The authors believe this negative effect was due to residual selection bias. The program's initial eligibility requirements included child malnutrition (subjectively assessed) as a criterion. As a consequence, the program might have initially enrolled many malnourished children.

The Guatemala study looked at the impact of daycare on child dietary intake on weekdays while attending daycare, on weekdays before and after the children stayed in daycare and

[3] 95% CI could not be calculated as the authors do not report standard errors for the cumulative effects.

during weekends (Ruel et al., 2006). The results from the matching by design were only presented in graphs. The propensity score matching results were very similar, however, albeit with lower levels of statistical significance. The program had a positive effect on the percentage of daily requirements consumed while at daycare: energy increased by 12 percentage points (95% CI: 7.9, 16.2), protein by 26 percentage points (17.1,34.4), iron by 22 percentage points (7.8, 30.9) and vitamin A by 85 percentage points (48.6, 126.4). Additionally, the program improved the diet while not at daycare. Positive effects were found for the times before and after the children's stay in daycare on weekdays: energy increased by 5 percentage points (-0.1, 9.4), iron by 13 percentage points (3.6, 20.2) and vitamin C by 15 percentage points (3.2, 29.5). These results show that the positive effect on child dietary intake while at daycare was not attenuated by substitution at home. During the weekends, the percentage of daily requirements consumed increased by 24 (5.5, 41.3) and 57 percentage points (13.5, 96.3) for energy and protein respectively. Potentially worrisome is the finding that close to half of the effect on vitamin A intake could be attributed to the consumption of sugar (which is fortified with vitamin A in Guatemala) in sweetened homemade fruit juices in the daycare centers. Increased sugar consumption is not considered a positive outcome.

Impact on child development (see **Table 3.3) -**Three studies evaluated the impact on child development (Colombia (Bernal et al., 2009), Bolivia (Behrman et al., 2004) and Argentina (Berlinski et al., 2009)) and one estimated the effect on schooling (Uruguay (Berlinski et al., 2008)).

The program in Colombia had a generally positive effect on child development (Bernal et al., 2009; Universidad de los Andes and Profamilia, 2009). Psychosocial development was measured using the Early Development Instrument (EDI section on social and emotional development) and Penn Interactive Peer Play Scale (PIPPS). No effect was found on the EDI. The impact on the PIPPS (scale range: 1 to 4) was mixed: aggressive behavior increased by 0.085 points (95% CI: 0.026, 0.144) (a 5% increase)[4] in children between the age of 36 and 48 months who had attended the program for more than 5 months. Social isolation, however, dropped by 0.128 points (-0.167, -0.089) (9%) and adequate interaction increased by 0.240 points (0.162, 0.318) (8%) in the same children. The authors explained the results as follows: children in a HCB were exposed to more interactions with other children and while they were learning to "negotiate" (competition over toys, turns, etc), it is "normal" to observe more aggressive behavior in children. Cognitive development was measured using the EDI instrument (section on language and cognitive skills; range 0 to 1), the Peabody Picture Vocabulary Test and the Woodcock Johnson-Muñoz (WJM) test. Positive impacts were found on the EDI but only among children older than 49 months. The impacts were 0.027 (0.007, 0.047) and 0.029 points (0.009, 0.049) (10%) for an exposure of 2 to 4 and 5 to 15 months respectively and 0.096 points (0.076, 0.116) (34%) for children with an exposure of more than 16 months. The positive impact on the Peabody Picture Vocabulary Test (scale range: 55 to 145; population level mean (SD)=100 (15)) was limited to children who had been in the program for over 16 months (2.18 points (0.39, 3.96) (2.4%) for children between 36 and 48 months and 4.8 (2.21, 7.38) (5%) points for children over 49 months). Finally, the WJM test (population level mean (SD)=100(15)) showed that the program had no impact on intellectual ability, a positive impact (3.48 points (0.63, 6.32), 4%) on verbal ability among children 49 months or older who had been in the program for over 16 months and positive impacts on

[4] The authors reported the development results as changes in absolute scores. Where the overall mean values are provided by the authors, we express the impact as a percentage change. Note, however, that this percentage change is based on the overall mean and not on the age and exposure-specific mean (not provided by the authors).

mathematical reasoning (3.8 points (1.62, 5.98) (5%) and 4.3 points (1.46, 7.07) (5%)), and general knowledge (2.2 points (0.19, 4.15) (3%) and 3.4 points (1.11, 5.62) (4%)) among children between 36 and 48 months and over 48 months respectively with more than 16 months of exposure. Finally, the authors also estimated medium term impacts on test scores at 5th grade of primary school. They found an increase of 14.5 percentage points (2.9, 26.1) on total test scores (Bernal et al., 2009; Universidad de los Andes and Profamilia, 2009).

The Bolivia daycare program had a positive effect on bulk (gross) and fine motor, language and psycho-social skills. (Behrman, Cheng y Todd 2004; 86:108-132) When matching children in the program to non-participating eligible children living close to PIDI centers, the program was found to increase all of the skills by 2 to 6% in children between the age of 37 and 58 months (but not in children younger than 37 or older than 58 months). The cumulative impact estimates showed that the effects were positive (2 to 11% increase) for children who had been in the program for over 13 months and who were 25 to 58 months of age. Larger effects were found when the program children were matched to eligible children living in poor urban areas not served by PIDI. Attending daycare had a significantly positive effect on all skills in children older than 42 months (3 to 8%). The cumulative analyses showed that the program had a positive impact (2 to 11%) for children who were in the program for at least 7 months. In the final set of analyses, the authors only considered children in the program and evaluated the impact of having been in the program for one month or less as compared to at least 2 months. The program significantly increased all skills (2 to 9%) for children older than 42 months. The cumulative estimates found that the program had a positive impact (2 to 10%) for children who had been in the program for at least 13 months. Given the residual (negative) selection bias found for child growth (see above), the development effects might be underestimated.

In the case of the Argentina evaluation, Berlinski and colleagues first estimated the association between the construction of new preschool places and preschool enrollment (Berlinski et al., 2009). They showed that every newly created preschool place was taken up. As a consequence, the estimated effects of each additional preschool place per child can also be interpreted as the effect of attending preschool. The program was found to have a positive effect on the mathematics and Spanish test scores of 3rd graders. An increase of one preschool place per child increased test scores by 8% (mathematics scores increased by 4.69 points (95% CI: 0.90, 8.48) and Spanish scores by 4.76 points (0.69, 8.83)). The estimated effect of one year of preschool for all students in a class of 3rd graders had a positive effect on the teachers' perception of students' attention (likelihood that at least half of them pay a lot of attention in class increased by 12 percentage points (0.0, 24.4)), effort (21 percentage points (3.7, 38.5)) and regular participation (16.5 percentage points (2.2, 30.8)). No effect was found on teachers' perception of discipline.

Having attended at least one year of preschool in Uruguay had a positive effect on school attendance (Berlinski et al., 2008). Using ordinary least squares (OLS) regression estimation, the authors found that the effect increased from 4.3 percentage points (95% CI: 0.4, 8.2) at the age of 7 years to 27.4 percentage points (16.4, 38.4) for children who were 15 years old. The effect on school attendance was larger for children of mothers with lower levels of education (26.9 percentage points (14.0, 39.8) *vs.* no preschool effect in children of higher education mothers) and in children outside of the capital city of Montevideo (34.2 (21.7, 46.7) *vs.* 20.3 percentage points (4.0, 36.6)). No differences in effect were found for boys or girls. The instrumental variables (IV) estimate for children who were 15 years old was a 39.8 percentage points (0.178, 0.618) increase in school attendance. The IV estimates did not show the monotonic increase in effect size with age. The program also led

to an increase on years of schooling. The effect estimated with OLS steadily increased with age, from (a surprisingly negative effect of) -0.341 years (-0.637, -0.045) at 7 years of age to 0.788 years (0.48, 1.096) at the age of 15. As for school attendance, the effects were larger for children of mothers with low levels of education (0.741(0.318, 1.164)) than for children of mothers with higher levels of education where the effect was non-significant at 15 years of age. It was also higher for children outside of Montevideo (0.923 (0.317, 0.869) *vs.* 0.593 (0.402, 1.444) at 15 years old). The effect was not different for boys and girls. The instrumental variables estimate for children at 14 years of age was 0.871 years (0.109, 1.633), but the effect for 15 year olds did not reach statistical significance. It is important to note that the authors did not provide gender specific attendance and grade progression descriptive statistics. It is thus impossible to evaluate to what extent the difference in effects by maternal education and location are due to preexisting differences in attendance rates and years of schooling. The results by years of preschool attended (presented as graphs) show that returns to additional years of preschool (above and beyond one year) are insignificant. A limitation of the study is that the identification of the program effect hinges on the existence of families with sibling variability in preschool attendance. It is not clear to what extent these households might be different than the "average" beneficiary households and thus whether and how this estimation strategy might have biased the results.

Pathways

The reviewed studies provide no or only very limited information on the possible mechanisms by which daycare programs affect child outcomes. The one exception is the Guatemala study. This study showed that the program not only improved child dietary intake while at daycare but also when at home (Ruel et al., 2006). This indicates that the effects these programs might have on child nutritional status (which was not assessed in this study) operated directly through the benefits children receive from the program and indirectly through improvements at home. It is not clear whether the improved diet at home was a consequence of higher income, better maternal knowledge or a combination of both. The Guatemala study also included a strong operational evaluation which identified a number of factors that were reducing the potential impact the program might have. These included problems such as the need for additional training of the caretakers on using menus and substituting foods, the inadequacy of the amount of cash the *hogares* receive earmarked for food, the large amount of time spent away from the daycare center to collect the program cash, delays in receiving the food donations, leaving the children unattended to buy food, and the little time spent on psycho-social activities. Finally, a companion document provided useful information on the care poor children received. These were children who did not attend daycare and whose mothers were working in Guatemala City. The limited availability of child care alternatives (both formal and informal) leaves mothers with no alternative but to work in the informal sector. In a random sample of mothers working in the slums of Guatemala City, more than 40% reported caring for their children while working (IFPRI, 2003). This indicates that notwithstanding the often inadequate quality of the *hogares*, they most likely provided better care to children than what their working mothers could offer.

Berlinski et al. (2009) suggested that the positive impact on student behavior in Argentina might be part of the pathway by which pre-primary school participation exerts its impact on school test performance. The authors did not, however, test this pathway quantitatively.

As in Guatemala, the Colombia program suffered from a number of problems limiting its potential impact. A first limitation is the limited knowledge of the *Madres Comunitarias* with respect to child development, safety and effective care practices. On average, *Madres Comunitarias* knowledge of infant development was low and not very different from the

beneficiary mothers' knowledge (a score of 58% *vs.* 54% on the Knowledge Infant Development Inventory (KIDI)). The quality of care was low as well: using the Family Day Care Rating Scale (FDCRS)[5], the mean score was 2.67 (out of 7), suggesting that only the minimum conditions for an adequate early childhood care environment were met. Children were mostly engaged in free play (Bernal and Helo, 2010).

Demand for services

In the first Colombia study (Attanasio et al., 2010) attendance in rural areas was found to be higher when parents lived closer to the daycare center and when the fees were lower. The child's birth order and the mother's age were positively associated with the time the child spent in daycare. This appears to indicate that parents with more children used daycare service more often. In urban areas, the same association with maternal age (but not with birth order) was found. Attendance was found to be significantly lower in the SISBEN3 group which was expected as program eligibility was limited to SISBEN 1 and 2 households. Maternal education was not associated with attendance in rural or urban areas.

The second Colombia study (Bernal et al., 2009) found that attending daycare increased with birth order, maternal education and the head of household being employed. Household size, however, was negatively associated with attendance. The association between household wealth and attending daycare was not consistent.

The Bolivia study (Behrman et al. 2004) is the only one comparing beneficiary characteristics of participants, non-participants and eligible non-participants. Compared to non-participant mothers, participant mothers and fathers had lower levels of education. A small proportion of participant mothers was literate and even fewer had jobs. These differences mostly disappeared, however, when eligibility was imposed on the non-participant sample. The income of fathers was comparable across groups; the income of participant mothers, on the other hand, was lower even in comparison with eligible non-participants. Participant households were less likely to have both parents reside in the household (this difference disappeared when compared to eligible non-participants). Total and per capita household income were lower in participant households than in (eligible) non participant households. In brief, participant households were economically worse off than non-participant households, even when restricting the latter sample to eligible households.

The Guatemala study (Ruel et al., 2006) compared participants to matched non-participants (living in the same neighborhood and matched on child age, sex and maternal employment) and to working mothers from a random sample of households living in the same area. Compared to both samples, participant mothers were slightly less educated and had poorer housing arrangements. Their household size was smaller but the dependency ratio was higher. They were more likely to have a malnourished child.

In Uruguay (Berlinski et al. 2008) lower educated mothers were less likely (12.2 percentage points) to participate in the program, but this difference decreased as the coverage of the program expanded.

[5] The FDCRS evaluates quality of care in 6 domains: space and furnishings for care and learning, basic care routines, language and reasoning, learning activities, social development and adult needs (the relationship with parents, staff development, etc). See http://www.fpg.unc.edu/~ECERS/fdcrs_frame.html

Table 3.3 Summary of included studies: health outcomes[6]

Country Reference	Intervention	Comparison	Study quality assessment	Outcome measure	Descriptive statistics	Effect size (95% CI)
Colombia Bernal et al. (2009)	Hogares Comunitarios de Bienestar (HCB). Madres comunitarias (MC) provide childcare in their homes for a small monthly fee (3.5 USD/mo in 2008) to groups from 12 to 14 children 0 to 6 y. Care includes lunch and snacks (50% to 70% of caloric and nutritional needs). There are two modalities full time or part time. **Eligibility criteria:** households with children 0 to 6 y belonging to SISBEN[7] levels 1 to 2.	**Treatment**: 2-4, 5-15 and 16+ mo of attendance (*vs.* <1 mo)[8] **Analyses**: propensity score matching (kernel) Medium term impact of the program on test scores in 5th grade, using instrumental variables.	• Matched treatment-control estimates suffer from selection bias; • Not clear how subsample was selected; • Relatively low prevalence of malnutrition, so potential to benefit is low; • Positive effect on diarrhea and ARI might be due to an increase in morbidity in children just after joining daycare	Diarrhea, acute respiratory infections (ARI), complete vaccination scheme.	**Diarrhea:** 15.65% **ARI**: 5.33% **Complete vaccination scheme:** 20.05%	**Diarrhea:** 0-24 mo: -6.9pp (-12.8, -1.0) if exposure 16+ mo; 25-36 mo: -4.2pp (-8.1, -0.3) if exposure 5-15mo and -6.8pp (-10.7, -2.9) if exposure 16+ mo; 49+ mo**:** -4.2pp (-4.6, -3.8) if exposure 16+ mo; all other age/exposure combinations: NS. **ARI**: 0-24 mo: -3.4pp (-3.6, -3.2) if exposure 16+ mo; 25-36 mo: -3pp (-5,-1)if exposure 16+ mo; all other age/exposure combinations: NS. **Complete vaccination:** Age 0-24 mo: -3.9pp (-7.9, 0.0) if exposure 16+ mo. Age 25-36 mo: +2.9pp (0.9, 4.9) if exposure 16+ mo.

[6] Additional study details are provided in Appendix C

[7] SISBEN: Identification System of Potential Beneficiaries of Social Programs (*Sistema de Identificación de Potenciales Beneficiarios de Programas Sociales*)

[8] Program impact was estimated using 3 different comparisons: treatment *vs.* control, children exposed for <1, 2-4, 5-15 and over 16 months *vs.* control and children exposed ≤ 1 month *vs.* 2-4, 5-15 and over 16 months. The results strongly indicate that the impact estimates using the control group as the counterfactual suffer from selection bias. This was confirmed by the author (personal communication with Raquel Bernal, December 2010). We only report and discuss the results obtained from the estimations using the <1 *vs.* >1 exposure comparison.

Table 3.2 Summary of included studies: nutrition outcomes

Country *Reference*	Intervention	Comparison	Study quality assessment	Outcome measure	Descriptive statistics	Effect size (95% CI)[9]
Colombia Attanasio et al. (2010)	*Hogares Comunitarios de Bienestar (HCB).* *Madres comunitarias* provide childcare in their homes for a small fee to groups of up to 15 children 0 to 6 y. Care includes lunch, 2 snacks and a nutritional beverage (70% of caloric needs) **Eligibility criteria:** households with children 0 to 6 y belonging to SISBEN levels 1 to 2 (SISBEN is an indicator of economic well-being; indicator ranges from 1 (poorest) to 6).	**Treatment**: current attendance (*vs.* not attending) and exposure to HCB (fraction of life spent in HCB) **Analyses**: instrumental variable regression. Overall impact and impact by child height quintiles.	• The FeA sample only includes SISBEN 1 households; • Not clear how many children were excluded from the analyses; • Effect sizes are biologically implausible; • Unlikely that program effect is linear with respect to exposure (i.e. proportion of the child's life spent in daycare); • Not clear how 3 rounds of panel data were modeled.	Child height (HAZ)	**HAZ:** Rural: -1.25 SD Urban: -0.77 SD **Stunting:** Rural: 23.7% Urban: 11.2%	**Overall:** **Current attendance:** Rural: +0.448SD (0.076, 0.820) Urban: +0.826SD (0.450, 1.202) **Exposure** (=1 if exposed entire life)**:** Rural: +0.945SD (0.228, 1.662) Urban:+1.227SD (0.512, 1.942) **Height quintile results:** **Current attendance:** Rural: quintile 1 +0.65SD (0.081, 1.217) to NS in quintile 5 Urban: quintile 1 +1.33SD (0.767, 1.895) to NS in quintile 5 **Exposure** (=1 if exposed entire life)**:** Rural: +1.737 SD (0.044, 3.43) in quintile 1 to NS in quintile 5 Urban: +3.419SD (1.312, 5.526) in quintile 1 to NS in quintile 5.
Colombia Bernal *et al*. (2009)	*Hogares Comunitarios de Bienestar (HCB).* *Madres comunitarias* (MC) provide childcare in their homes for a small monthly fee (3.5 USD/mo in 2008) to groups from 12 to 14 children 0 to 6 y. Care includes lunch and snacks (50% to 70% of caloric and nutritional needs). There are two modalities: full time or part time. **Eligibility criteria:** households with children 0 to 6 y belonging to SISBEN[10] levels 1 to 2.	**Treatment**: 2-4, 5-15 and 16+ mo of attendance (*vs.* <1 mo)[11] **Analyses**: propensity score matching (kernel) Medium term impact of the program on test scores in 5th grade, using instrumental variables.	• Matched treatment-control estimates suffer from selection bias; • Not clear how subsample was selected; • Relatively low prevalence of malnutrition, so potential to benefit is low; • Positive effect on diarrhea and ARI might be due to an increase in morbidity in children just after joining daycare	Stunting (HAZ<-2SD), underweight (WAZ<-2SD) and wasting (WHZ<-SD);	**Stunting:** 12.96% **Underweight:** 7.02% **Wasting:** 1.59%	**Stunting:** 0-24 mo: +6.3pp (2.4, 10.2) if exposure 2-4 mo; all other age/exposure combinations: NS; **Underweight:** 25-36 mo: -2.6pp (-4.6, -0.6) if exposure 5-15 mo; 37-48 mo:-2.1pp (-4.1, -0.1) if exposure 5-15 mo; all other age/duration combinations: NS; **Wasting:** NS

[9] 95% CI were calculated as follows: *estimated impact ± 1.96 × reported standard error*

[10] SISBEN: Identification System of Potential Beneficiaries of Social Programs (*Sistema de Identificación de Potenciales Beneficiarios de Programas Sociales*)

Country *Reference*	Intervention	Comparison	Study quality assessment	Outcome measure	Descriptive statistics	Effect size (95% CI)[9]
Bolivia Behrman et al. (2004)	*Programa Integral de Desarrollo Infantil (PIDI)* Childcare in homes of women in low-income areas; up to 15 children per PIDI, 1 staff/5 children. Food provided (70% of nutritional needs), health and nutrition monitoring and educational activities. Full time, no fees charged **Eligibility criteria[12]:** Children 6-72 mo, poor urban areas, household eligibility evaluated using an index based on housing characteristics and working status	**Treatment**: attendance (participants (a) *vs.* eligible non participants living close (b) or in areas not served by program (c)), cumulative impact (1-6, 7-12, 13-18, 19-24 and 25+ mo; comparisons as for attendance), ≤1 mo *vs.* ≥2 mo **Analyses**: generalized matching estimator	Not clear how many children were excluded from the analyses	Height-for-age (HA) percentile, weight-for-age (WA) percentile	Reported in graphs. **HA**: Overall mean around 20th percentile. PIDI children >12mo shorter than (b) and (c) comparison children. **WA:** Overall mean around 35th percentile. No apparent differences between groups.	**(a) vs (b)** **attendance & cumulative: NS** **(a) vs (c)** **attendance:** **HA%:** NS **WA%:** all ages negative (-5.0 (-9.9, -0.1) to -7.5pp (-12.8, -2.2)), except for for 42-58mo (NS) (probably due to residual selection bias) **cumulative:** **HA%:** NS **WA%[13]:** -6.8 to -8.9 pp for short duration (<12 mo) of exposure (probably due to residual selection bias) **≤1 mo vs ≥2 mo** **attendance & cumulative:** NS

[11] Program impact was estimated using 3 different comparisons: treatment *vs.* control, children exposed for <1, 2-4, 5-15 and over 16 months *vs.* control and children exposed ≤ 1 month *vs.* 2-4, 5-15 and over 16 months. The results strongly indicate that the impact estimates using the control group as the counterfactual suffer from selection bias. This was confirmed by the author (personal communication with Raquel Bernal, December 2010). We only report and discuss the results obtained from the estimations using the <1 *vs.* >1 exposure comparison.

[12] Eligibility criteria changed. The latest criteria are reported here. The original criteria included child malnutirition (no objective measure was used to verify it).

[13] 95% CI could not be calculated as the authors do not report standard errors for the cumulative effects.

Country *Reference*	Intervention	Comparison	Study quality assessment	Outcome measure	Descriptive statistics	Effect size (95% CI)[9]
Guatemala Ruel et al. (2006)	*Hogares Comunitarios (HC)* Daycare provided by women in the community to up to 10 children 0 to 7 y of age Monday to Friday from 6 a.m. to 6 p.m. Care includes breakfast, lunch, and 2 snacks (80% of nutrient requirements); psycho-pedagogical activities, general care and hygiene. **Eligibility criteria:** Children 2 to 7 y, mothers working outside the home, 1 urban zone in Guatemala City.	**Treatment:** attending daycare (*vs.* not attending) **Analyses**: matching by design (at the time of subject selection), propensity score matching (PSM, nearest neighbor (NN) and kernel)	Not clear to what extent limiting the PSM to the common support affected the internal validity of the results	Percentage of child daily energy and nutrient requirements (protein, Ca, Fe, Vit C, Vit A, Zn)	Results presented in graphs	**Match by design:** Results presented in graphs (not tables); similar to PSM results. **PSM (kernel)*** **Weekdays, during stay in place of care:** **Energy:** +12.4pp (7.9, 16.2); **Protein:** +25.7pp (17.1,34.4); **Ca**: NS ; **Fe**: +21.6pp (7.8, 30.9); **Vit C:** NS; **Vit A:** +85.2pp (48.6, 126.4); **Zn**: NS **Weekends: Energy:** 23.6pp (5.5, 41.3); **Protein:** +57.5 (13.5, 96.3)pp; **Ca**: NS ; **Fe**: NS; **Vit C:** NS; **Vit A:** NS; **Zn**: NS **Weekdays, before and after stay in place of care:** **Energy:** +5.3pp (-0.1,9.4); **Protein:** NS; **Ca**: NS ; **Fe**: +13.4pp (3.6, 20.2); **Vit C:** 14.7pp (3.2, 29.5); **Vit A:** NS; **Zn**: NS *NN estimates had a substantially lower sample size No evidence of substitution home diet.

Table 3.3 Summary of included studies: development outcomes

Country *Reference*	Intervention	Comparison	Study quality assessment	Outcome measure	Descriptive statistics	Effect size (95% CI)
Colombia Bernal *et al*. (2009)	Hogares Comunitarios de Bienestar (HCB). Madres comunitarias (MC) provide childcare in their homes for a small monthly fee (3.5 USD/mo in 2008) to groups from 12 to 14 children 0 to 6 y. Care includes lunch and snacks (50% to 70% of caloric and nutritional needs). There are two modalities full time or part time. **Eligibility criteria:** households with children 0 to 6 y belonging to SISBEN[14] levels 1 to 2.	**Treatment**: 2-4, 5-15 and 16+ mo of attendance (*vs.* <1 mo)[15] **Analyses**: propensity score matching (kernel) Medium term impact of the program on test scores in 5th grade, using instrumental variables.	• Matched treatment-control estimates suffer from selection bias; • Not clear how subsample was selected; • Relatively low prevalence of malnutrition, so potential to benefit is low; • Positive effect on diarrhea and ARI might be due to an increase in morbidity in children just after joining daycare	Early Development Instrument (EDI), Penn Interactive Peer Play Scale (PIPPS): Peabody Picture Vocabulary Test (Peabody), Woodcock Johnson-Muñoz (WJM); and test scores in 5th grade.[16]	**EDI social:**1.55 **PIPPS:** aggressive behavior: 1.83; social isolation: 1.40; adequate interaction: 3.05 **EDI cognitive**: 0.28 **Peabody**: 90.53 **WJM:** intellectual ability: 86.45; verbal ability: 80.89 mathematical reasoning: 82.00; general knowledge: 78.42 **Total test score** in 5th grade: 36.36%	**EDI social:** NS **PIPPS:** Aggressive behavior: 36-48 mo: +0.085 (0.026, 0.144) in the index if exposure 5-15 mo and +0.085 (0.007, 0.163) if 16+ mo. Social isolation: 36-48 mo: -0.128 (-0.167, -0.089) if exposure 16+ mo. Adequate interaction: 36-48 mo: +0.240 (0.162, 0.318) if exposure 16+ mo. **EDI cognitive:** 49+ mo: +0.027 (0.007, 0.047) to +0.029 (0.009, 0.049) if exposure 2-15mo; +0.096 (0.076, 0.116) if exposure 16+ mo. **Peabody:** 36-48 mo:+2.18 (0.39, 3.96) if exposure 16+ mo; 49+ mo: +4.80 (2.21, 7.38) if exposure 16+ mo. **WJM:** Intellectual ability: NS. Verbal ability: 49+ mo: +3.48 (0.63, 6.32) if exposure 16+ mo. Mathematical reasoning: 36+ mo: +3.80 (1.62, 5.98) to +4.26 (1.46, 7.07) if exposure 16+ mo. General knowledge: 36+ mo: +2.17 (0.19, 4.15) to +3.36 (1.11, 5.62) if exposure 16+ mo. **Total test score** in 5th grade: +14.5pp (2.9, 26.1)

[14] SISBEN: Identification System of Potential Beneficiaries of Social Programs (*Sistema de Identificación de Potenciales Beneficiarios de Programas Sociales*)

[15] Program impact was estimated using 3 different comparisons: treatment *vs.* control, children exposed for <1, 2-4, 5-15 and over 16 months *vs.* control and children exposed ≤ 1 month *vs.* 2-4, 5-15 and over 16 months. The results strongly indicate that the impact estimates using the control group as the counterfactual suffer from selection bias. This was confirmed by the author (personal communication with Raquel Bernal, December 2010). We only report and discuss the results obtained from the estimations using the <1 *vs.* >1 exposure comparison.

[16] **Early Development Instrument (EDI):** caregiver's (the mother in this case) perception of the psychosocial development of the child (range: 1 to 3; lower score indicates fewer behavior problems). **Penn Interactive Peer Play Scale (PIPPS)**: maternal report in the control group and *madres comunitarias'* report of children in the treatment group, about child social conduct during play time (range: 1 to 4). **EDI cognitive**: maternal report of the cognitive development of her child (range: 0 to 1; lower score is better). **Peabody Picture Vocabulary Test**: scale of verbal skills directly applied to children (scale range 55 to 145, larger is better. Population level mean (SD)=100(15)). **Woodcock Johnson-Muñoz (WJM):** test of intellectual ability, verbal ability, mathematical reasoning and general knowledge applied directly to children (standardized scores for age, larger numbers are better. Population level mean (SD)=100(15)).

Country *Reference*	Intervention	Comparison	Study quality assessment	Outcome measure	Descriptive statistics	Effect size (95% CI)
Bolivia Behrman et al. (2004)	*Programa Integral de Desarrollo Infantil (PIDI)* Childcare in homes of women in low-income areas; up to 15 children per PIDI, 1 staff/5 children. Food provided (70% of nutritional needs), health and nutrition monitoring and educational activities. Full time, no fees charged **Eligibility criteria[17]:** Children 6-72 mo, poor urban areas, household eligibility evaluated using an index based on housing characteristics and working status	**Treatment**: attendance (participants (a) *vs.* eligible non participants living close (b) or in areas not served by program (c)), cumulative impact (1-6, 7-12, 13-18, 19-24 and 25+ mo; comparisons as for attendance), ≤1 mo *vs.* ≥2 mo **Analyses**: generalized matching estimator	Not clear how many children were excluded from the analyses	Bulk motor, fine motor, language and auditory, and psycho-social skills.	**Test scores**: Reported in graphs. No apparent differences between groups.	**(a) *vs.* (b)** **attendance:** age 37-58 mo: all scores +2 to 6%; other ages: mostly NS **cumulative[18]:** age 25-58 mo: mostly positive (2 to 11%) if duration >13 mo **(a) *vs.* (c)** **attendance:** age 42 to 59+ mo: all scores +3 to 8%; other ages: mostly NS **cumulative[18] :** all ages: mostly positive (2 to 11%) if duration >7 mo **≤1 mo *vs.* ≥2 mo** **attendance:** age 42 to 59+ mo: all scores +2 to 9%; younger ages: mostly NS **cumulative[18]:** all ages: mostly positive (2 to 10%) if duration >13 mo; lower duration, some positive
Argentina Berlinski et al. (2009)	Expansion of public pre-primary school provision (through construction of classrooms) from 93-99. Pre-primary for children 3 to 5, 3.5 hrs / day, two shifts (am and pm), 5 days a week, 9 mo school year. Class size: 25 children. **Eligibility criteria**: Children 3 to 5y. Last year of pre-primary school compulsory since 1993.	**Treatment:** supply of pre-primary schools, attending pre-primary school. **Analyses:** Retrospective. Used exogenous increase in pre-primary school availability (construction of 3724 classrooms from 93-99) as treatment variable; interacted with child gender and municipality specific poverty level to estimate effect modification.	Not clear how many children were excluded from the analyses	Spanish and mathematics test scores; teachers' perception of student behavior (attention, effort, class participation, discipline)	**Mathematics (sd):** 61.14 (19.70) **Spanish (sd):** 62.79 (20.41) **Behavior:** Half or more of my students… Pay a lot of attention**:** 89.9% Put a lot of effort: 87.1% Are well disciplined: 75.6% Participate regularly: 83.5%	**Mathematics:** Overall: +4.69 (0.90, 8.48) (+8%) Gender interaction: NS Poverty interaction: NS **Spanish:** Overall: +4.76 (0.69, 8.83) (+8%) Gender interaction: NS poverty interaction: higher if poorer **Behavior**: Half or more of my students… Pay a lot of attention: +12.2pp (0.0, 24.4) Put a lot of effort: +21.1pp (3.7, 38.5) Are well disciplined: NS Participate regularly: +16.5pp (2.2, 30.8)

[17] Eligibility criteria changed. The latest criteria are reported here. The original criteria included child malnutirition (no objective measure was used to verify it).

[18] Behrman et al.'s cut-off is 10% for the cumulative results.

Country *Reference*	Intervention	Comparison	Study quality assessment	Outcome measure	Descriptive statistics	Effect size (95% CI)
Uruguay Berlinski et al. (2008)	Expansion of public pre-primary school classrooms from 1995-2002. Pre-primary services for 3 to 5 y olds; 4 hrs/day, two shifts (am and pm), 5 days a week during 180 day school term. The program aim was to promote child's early socialization and alphabetization. **Eligibility criteria**: Children 3-5y. Pre-primary school is compulsory for children 4 to 5 y.	**Treatment:** attended <1 y *vs.* ≥1 y, ≥2 *vs.* 1 and 3 *vs.* 2 y of preschool **Analyses**: within household estimator, using variability between siblings and controlling for birth order, sex, mother´s age and education, living in Montevideo or not, household fixed effects. Additionally, preschool attendance instrumented with average locality and cohort-specific attendance rates.	• Not clear how many children were excluded from the analyses; • No gender specific attendance and grade progression descriptive statistics provided, so impossible to evaluate to what extent the difference in effects by maternal education and location are due to preexisting differences; • Not clear whether households with between sibling variability are different than average beneficiary households.	School attendance, years of schooling.	**School attendance:** 0.97 **Years of schooling** (primary & secondary): 4.59	**School attendance:** **OLS: <1 y *vs.* ≥1**: effect grows with age from +4.3 (0.4, 8.2) at 7y to + 27.4pp (16.4, 38.4) at 15y; larger for low educated moms +26.9 (14.0, 39.8) *vs.* NS at 15y, outside Montevideo (+34.2 (21.7, 46.7) *vs.* +20.3pp (4.0, 36.6) at 15y); results by sex NS **Intensive margin:** Returns to additional years of preschool (above and beyond one year) NS **IV:** +39.8pp (0.178, 0.618) at 15y (other ages NS, no clear increase with age) **Years of schooling:** **OLS: <1 y *vs.* ≥1:** effect grows with age from -0.341y (-0.637, -0.045) at 7y to +0.788y (0.48, 1.096) at 15y; larger for low educated moms (0.741y (0.318, 1.164) *vs.* NS at 15y), outside Montevideo (0.923 (0.317, 0.869) *vs.* 0.593y (0.402, 1.444) at 15y); results by sex NS **Intensive margin:** Returns to additional years of preschool (above and beyond one year) are insignificant **IV:** +0.871y (0.109, 1.633) at 14y (other ages NS, increase with age)

6. Discussion

We reviewed the literature on the impact of daycare programs on child health, nutritional status, and development in low and middle income countries. We identified studies of programs from around the world. Studies meeting our inclusion criteria, however, were rare and were all conducted in Latin America. Drawing conclusions from the available evidence is challenging, as the outcomes studied were mostly unique to each paper.

Only one study evaluated the impact on child health. Significant reductions in the prevalence of diarrhea and acute respiratory infections in children with longer exposures to the program were found in the second Colombia evaluation as compared to children with shorter exposure to daycare. Those effects could have, however, been due to an increase in infections in children immediately after joining a daycare center, since these children – not those not attending daycare – constituted the comparison group. No consistent effect was found on vaccination rates. The impact on child nutrition outcomes is not clear. The Bolivia study found no impact on child growth. The large reported effect sizes in the first Colombia evaluation are biologically implausible. The second study of the Colombia program found inconsistent effects. A clear positive impact on child diet was found in Guatemala. In general, the few studies found large positive effects on measures of child development. The program in Colombia increased aggressive behavior but reduced social isolation and increased adequate social interaction in the short term; cognitive development (language, mathematical and general knowledge) improved as well. Additionally, positive long term effects were found. The study in Bolivia found short term effects on child motor, language, auditory and psycho-social skills. Longer term effects on test scores, child behavior, school attendance and years of schooling were found in Argentina and Uruguay.

A key limitation of the reviewed studies is the lack of information on the "net" treatment the daycare interventions bring about. We define this net treatment as the difference in the (quality of) care between the daycare program and the alternative forms of care the child receives in the absence of the program. This difference is what ultimately determines the potential impact a program might have. If daycare interventions provide a high quality alternative to working mothers who would otherwise take their young children to work, a positive impact on child outcomes can be expected. On the other hand, a program that pulls children from adequate family care into low quality daycare may have negative effects on children. The reviewed studies provide detailed descriptions of the programs themselves. Only the Guatemala study, however, described the care situation of children in the absence of the program: a large proportion of mothers working in Guatemala City's slums reported caring for their child while working. A good description of the situation of children in the absence of the program is important as it constitutes the counterfactual against which program impact is measured. A much better understanding of the difference between what the program offers and the situation without the program is indispensable to make useful policy recommendations.

A related shortcoming, which was also identified in a recent review of conditional cash transfer programs (Leroy, Ruel and Verhofstadt, 2009), is the very limited information on the pathways of impact. Apart from the information on the improved home diet in Guatemala, none of the studies provided information on how the daycare programs exerted their impact. The limited quality of services described in the Guatemala and Colombia studies indicates that the programs do not reach their full potential impact.

It is not unconceivable that daycare interventions have positive effects on some intermediary outcomes and negative effects on others, resulting in a limited or even negative impact on child outcomes. A beneficiary mother who finds a job as a consequence

of the program might be able to earn a higher income (allowing her to buy better foods for her children) but may also lack the time to care for her children. Social interaction between children may improve child development but may also increase morbidity. Ideally, programs should be designed after carefully measuring and analyzing all relevant intermediary variables and pathways through formative research. Rigorous impact evaluations should consider all of these intermediary variables as well. In sum, without a much better understanding of the care children receive in the absence of the program and the pathways of impact, the assumption that daycare will benefit children may not be warranted.

The importance of the context specific conditions was also confirmed in our analyses of the demand for services. We found very little consistency across studies with respect to the determinants of program participation. Depending on the study, for instance, mothers with higher levels of education were either more or less likely to send their children to daycare.

An important challenge in the evaluation of daycare interventions is the families' self selection into the program which makes the identification of a credible counterfactual difficult. Daycare programs do not just cater to parents who already work but also lead to women entering the labor market. Other women may be increasing the number of hours they work. Many of the parents who do not participate in daycare programs do so by choice. Randomized control designs are difficult to implement in the context of daycare programs. Individually randomizing households to receiving or not receiving daycare (using a wait list, for instance) may not be practical. First, the program to be evaluated is rarely the only daycare option available, so wait listed parents may explore and use other daycare options. Second, the existence of wait lists may actually spur community members to start providing daycare. Finally, as treatment children graduate from the program or drop out and daycare spots open up, it would be difficult to prevent wait-listed (i.e. control) children from enrolling in the program. A cluster randomized design is easier to implement, but does not come without its own challenges. Since only a potentially small proportion of the population participates in these types of programs, intent to treat analyses might not be able to detect a sizeable impact. A valid treatment on the treated approach would require a strategy to match beneficiary households to those in the control group who would benefit from the program if it were available.

The studies in this review use different non-experimental approaches to solve the selection bias problem: matching (either by design or analytically), instrumental variables or intra-family estimators and dose-response analyses (comparing children who just joined daycare to children who have been there longer). Even though the authors are confident that their approach gets around the selection bias problem, there are reasons to believe this might not be the case. The barely credible effect sizes in the first Colombia study puts into question the validity of the instruments used by the authors. The first author of the second Colombia study confirmed that the estimates based on the treatment-control matching suffered from selection bias. The identification strategy in Uruguay eliminated households with only one beneficiary child and all households in which all siblings received the same treatment. This inevitably leads to the question as to how representative the analyzed households were and whether solving one type of selection bias problem came at the expense of a different type of selection bias. Finally, the comparison of children with shorter and longer program exposure can produce invalid estimates for outcomes that change in the very short term such as child morbidity.

Future studies should consider using alternative evaluation designs and evaluate the extent to which they minimize the selection bias problem. These designs include randomized promotion of the daycare program and randomly changing the price of daycare. In these designs, having received the promotion or (lower) price is orthogonal to household

characteristics. As a consequence, they might serve as valid instruments to identify program impact.

Conclusions

In conclusion, the reviewed studies suggest that daycare programs have a positive impact on child development. The evidence on child nutrition and health outcomes is less clear. More rigorously conducted studies on the impact of daycare programs in low and middle income countries are needed. These should be conducted in a variety of settings and provide a clear description of the counterfactual care scenarios. There is a particular need for studies documenting the impact on health outcomes. These studies should use children not exposed to the program as the control to avoid the problem described for the Colombia study. Intermediary variables that help explain the pathways of impact need to be measured and taken into account in the analyses. Studying how child age changes the (relative) importance of each pathway (e.g., the tradeoff between income and care) would provide important insights as well. Additionally, the extent to which the characteristics of the care provided (e.g., number of children, hours per week spent in daycare) modify its effect should be studied. Finally, future studies should consider alternative evaluation designs that minimize the risk of selection bias.

7. Literature cited

Attanasio, O., Di Maro, V. and Vera-Hernández, M. (2010) Community nurseries and the nutritional status of poor children. Evidence from Colombia. Working paper (unpublished).

Baker-Henningham, H. and Lopez-Boo, F. (2010) Early Childhood Stimulation Interventions in Developing Countries: A comprehensive literature Review. IDB-WP-213, Interamerican Development Bank.Washington, D.C.

Behrman, J.R., Cheng, Y. and Todd, P.E. (2004) Evaluating Preschool Programs When Length of Exposure to the Program Varies: A Nonparametric Approach. Review of Economics and Statistics, 86(1), pp. 108-132.

Berlinski, S., Galiani, S. and Gertler, P.J. (2009) The effect of pre-primary education on primary school performance. Journal of Public Economics, 93, pp. 219-234.

Berlinski, S., Galiani, S. and Manacorda M. (2008) Giving Children a Better Start: Preschool Attendance and School-Age Profiles. Journal of Public Economics, 92, pp. 1416-1440.

Bernal, R., Fernández, C., Flores C.E. & Gaviria A. (2009) Evaluación de impacto del Programa Hogares Comunitarios de Bienestar del ICBF. Documentos CEDE, No. 005854, Centro de Estudios de Desarrollo Económico (CEDE), Universidad de los Andes, Bogotá, Colombia.

Bernal, R. and Helo, J. (2010) Evaluación de Impacto del Programa de Formación y Atención a la Primera Infancia. Facultad de Economía. Centro de Estudios de Desarrollo Económico (CEDE), Universidad de los Andes, Bogotá, Colombia.

Ceballos, M. & Martin, G. (2001) Participación y fortalecimiento institucional a nivel local en Colombia. (Centro Editorial Javeriano, CEJA)

Engle, P., Black, M., Behrman, J., Cabral de Mello, M., Gertler, P., Kapiriri, L., Martorell, R. and Young, M. (2007) Strategies to avoid the loss of developmental potential in more than 200 million children in the developing world. Lancet, 369(9557), pp. 229–242.

Engle, P.L., Menon, P., Garrett, J.L. & Slack, A. (1997) Developing a research and action agenda for examining urbanization and caregiving: Examples from southern and eastern Africa. Food Consumption and Nutrition Division Discussion Paper, No. 28, International Food Policy Research Institute, Washington, D.C.

Engle, P.L., Menon, P. & Haddad, L. (1989) Care and nutrition: concepts and measurements. International Food Policy Research Institute, Washington, D.C.

Engle, P.L. and Pedersen, M.E. (1989) Maternal work for earnings and children's nutritional status in urban Guatemala. Ecology of Food and Nutrition, 22(3), pp. 211-223.

IFPRI (2003) Guatemala City A Focus on Working Women and Childcare. IFPRI City Profiles, International Food Policy Research Institute (IFPRI), Whasington, D.C.

Leroy, J.L., Ruel, M. and Verhofstadt, E. (2009) The impact of conditional cash transfer programmes on child nutrition: a review of evidence using a programme theory framework. Journal of Development Effectiveness, 1(2), pp. 103-129.

McGuire, J., Popkin, B.M. (1989) Beating the zero sum game: Women and nutrition in the Third World. Food Nutr Bull, 11, pp.38-63.

Nores, M. and Barnett, W.S. (2010) Benefits of early childhood interventions across the world: (Under) Investing in the very young. Economics of Education Review, 29(2), pp. 271-282.

Quisumbing, A.R., Hallman, K. and Ruel, M.T. (2007) Maquiladoras and Market Mamas: Womens Work and Childcare in Guatemala City and Accra. J Dev Stud, 43(3), pp. 420-455.

Rossi, P.H., Lipsey, M.W. and Freeman H.E. (2004) Evaluation: a systematic approach. 7th ed. (Thousand Oaks: Sage Publications).

Ruel, M.T., Quisumbing, A.R., Hallman, K., de la Brière, B. and Coj de Salazar, N. (2006) The Guatemala Community Daycare Program: an example of effective urban programming. Research Report, No. 144, International Food Policy Research Institute, Washington, D.C.

Ruel, M.T. (2008) Addressing the underlying determinants of undernutrition: Examples of successful integration of nutrition in poverty-reduction and agriculture strategies. SCN news, No. 36, United Nations System.

Schroeder, D.G., Martorell, R., Rivera, J.A., Ruel, M.T. & Habicht J.P. (1995) Age differences in the impact of nutritional supplementation on growth. J Nutr, 125(4suppl), pp.1051S-1059S.

Shepherd, R. (1999) Social determinants of food choice. Proc Nutr Soc, 58(4), pp.807-812.

Universidad de los Andes and Profamilia (2009) Evaluación de Impacto del Programa Hogares Comunitarios de Bienestar del ICBF. Unión temporal Universidad de los Andes - Profamilia. Bogotá, Colombia.

Zoritch, B., Roberts, I. and Oakley, A. (2000) Day care for pre-school children. Cochrane

Database of Systematic Reviews 2000, No. 3, CD000564. DOI:

10.1002/14651858.CD000564

Appendix A: Search term syntax by source

DATABASE SEARCHED: PubMed				
DATE: 3 November 2009				
LIMITS: Publication date: 1980 -				
Search Term Syntax Used	**Fields Searched**	**# Articles**	**# Kept**	**Notes**
("child care" OR "infant care" OR "child daycare" OR "child daycare centres"[MeSH Terms] OR nursery OR nurseries OR nursery school OR nursery schools OR pre-school OR pre-schools OR kindergarten) AND ((health OR infection OR infections OR disease OR diseases OR morbidity OR diarrhea OR diarrhoea) OR (diet OR nutrition OR growth OR height OR weight OR stunting OR wasting OR anemia OR deficiency OR deficiencies OR nutrient OR nutrients) OR (intelligence OR infant development OR child development OR psychomotor OR motor OR sensory OR language OR social OR emotional OR cognitive OR cognition)) AND (child OR children OR preschool child OR preschool children OR infant OR infants) AND (developing country OR third world country OR low income country OR middle income country OR developing nation OR third world nation OR Afghanistan OR Albania OR Algeria OR Samoa OR Angola OR Argentina OR Armenia OR Azerbaijan OR Bangladesh OR Belarus OR Belize OR Benin OR Bhutan OR Bolivia OR Bosnia OR Herzegovina OR Botswana OR Brazil OR Bulgaria OR Burkina Faso OR Volta OR Burundi OR Cambodia OR Cameroon OR Cape Verde OR Central African Republic OR Chad OR Chile OR China OR Colombia OR Comoros OR Congo OR Zaire OR Costa Rica OR Côte d'Ivoire OR Ivory Coast OR Croatia OR Cuba OR Djibouti OR Dominica OR Dominican Republic OR Ecuador OR Egypt OR El Salvador OR Eritrea OR Ethiopia OR Fiji OR Gabon OR Gambia OR Georgia OR Ghana OR Grenada OR Guatemala OR Guinea OR Guyana OR Haiti OR Honduras OR India OR Indonesia OR Iran OR Iraq OR Jamaica OR Jordan OR Kazakhstan OR Kenya OR Kiribati OR Korea OR Kyrgyz Republic OR Kyrgyzstan OR Lao OR Latvia OR Lebanon OR Lesotho OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR Malawi OR Malaysia OR Maldives OR Mali OR Marshall Islands OR Mauritania OR Mauritius OR Mayotte OR Mexico OR Micronesia OR Moldova OR Mongolia OR Montenegro OR Morocco OR Mozambique OR Myanmar OR Namibia OR Nepal OR Nicaragua OR Niger OR Nigeria OR Pakistan OR Palau OR Panama OR Papua New Guinea OR Paraguay OR Peru OR Philippines OR Poland OR Romania OR Russia OR Russian OR Rwanda OR Samoa OR São Tomé OR Principe OR Senegal OR Serbia OR Seychelles OR Sierra Leone OR Solomon Islands OR Somalia OR South Africa OR Sri Lanka OR Kitts OR Nevis OR Lucia OR Vincent OR Grenadines OR Sudan OR Suriname OR Swaziland OR Syrian Arab Republic OR Syria OR Tajikistan OR Tanzania OR Thailand OR Timor-Leste OR Togo OR Tonga OR Tunisia OR Turkey OR Turkmenistan OR Uganda OR Ukraine OR Uruguay OR Uzbekistan OR Vanuatu OR Venezuela OR Vietnam OR West Bank OR Gaza OR Yemen OR Zambia OR Zimbabwe)	All fields	4,236	0	
DATABASE SEARCHED: EconLit				
DATE: 3 November 2009				
LIMITS: Publication date: 1980 -				
Search Term Syntax Used	**Fields Searched**	**# Articles**	**# Kept**	**Notes**
(child w care OR infant w care OR daycare OR nursery OR nurseries OR nursery w school+ OR pre-school+ OR kindergarten) AND ((health OR infection+ OR disease+ OR morbidity OR diarrhea? OR diarrhoea?) OR (diet OR nutrition OR growth OR height OR weight OR stunting OR wasting OR anemia OR deficiency OR deficiencies OR nutrient*) OR (intelligence OR infant w development OR child w	Abstract or title or keyword	1,344	2	One of the articles was also selected from BLDS and IFPRI websites.

development OR psychomotor OR motor OR sensory OR language OR social OR emotional OR cognitive OR cognition)) AND (child OR children OR preschool child OR preschool children OR infant+) AND (developing w countr* OR third w world w countr* OR low w income w countr* OR middle w income w countr* OR developing w nation+ OR third w world w nation+ OR Afghanistan OR Albania OR Algeria OR Samoa OR Angola OR Argentina OR Armenia OR Azerbaijan OR Bangladesh OR Belarus OR Belize OR Benin OR Bhutan OR Bolivia OR Bosnia OR Herzegovina OR Botswana OR Brazil OR Bulgaria OR Burkina Faso OR Volta OR Burundi OR Cambodia OR Cameroon OR Cape Verde OR Central African Republic OR Chad OR Chile OR China OR Colombia OR Comoros OR Congo OR Zaire OR Costa Rica OR Côte d'Ivoire OR Ivory Coast OR Croatia OR Cuba OR Djibouti OR Dominica OR Dominican Republic OR Ecuador OR Egypt OR El Salvador OR Eritrea OR Ethiopia OR Fiji OR Gabon OR Gambia OR Georgia OR Ghana OR Grenada OR Guatemala OR Guinea OR Guyana OR Haiti OR Honduras OR India OR Indonesia OR Iran OR Iraq OR Jamaica OR Jordan OR Kazakhstan OR Kenya OR Kiribati OR Korea OR Kyrgyz Republic OR Kyrgyzstan OR Lao OR Latvia OR Lebanon OR Lesotho OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR Malawi OR Malaysia OR Maldives OR Mali OR Marshall Islands OR Mauritania OR Mauritius OR Mayotte OR Mexico OR Micronesia OR Moldova OR Mongolia OR Montenegro OR Morocco OR Mozambique OR Myanmar OR Namibia OR Nepal OR Nicaragua OR Niger OR Nigeria OR Pakistan OR Palau OR Panama OR Papua New Guinea OR Paraguay OR Peru OR Philippines OR Poland OR Romania OR Russia? OR Rwanda OR Samoa OR São Tomé OR Principe OR Senegal OR Serbia OR Seychelles OR Sierra Leone OR Solomon Islands OR Somalia OR South Africa OR Sri Lanka OR Kitts OR Nevis OR Lucia OR Vincent OR Grenadines OR Sudan OR Suriname OR Swaziland OR Syrian Arab Republic OR Syria OR Tajikistan OR Tanzania OR Thailand OR Timor-Leste OR Togo OR Tonga OR Tunisia OR Turkey OR Turkmenistan OR Uganda OR Ukraine OR Uruguay OR Uzbekistan OR Vanuatu OR Venezuela OR Vietnam OR West Bank OR Gaza OR Yemen OR Zambia OR Zimbabwe)				

DATABASE SEARCHED: The World Bank

DATE: March 22, 2010.

LIMITS:

Search Term Syntax Used	Fields searched	# Articles	# Kept	Notes
Child care infant care child daycare child daycare centers nursery nurseries nursery school nursery schools pre-school pre-schools preschools kindergarten	All fields	25	0	

DATABASE SEARCHED: JOLIS

DATE: June 23, 2010.

LIMITS:

Search Term Syntax Used	Fields	# Articles	# Kept	Notes
preschools OR kindergarten OR nursery OR nurseries OR preschools OR infant AND care	All fields	814	0	
child AND daycare OR nursery AND school OR pre-school OR preschool				
child AND care OR nursery AND schools OR pre-schools				
child AND daycare AND centers				

DATABASE SEARCHED: Internet Documents in Economics Access Service (IDEAS)

DATE: April 3, 2010.

LIMITS:

Search Term Syntax Used	Fields searched	# Articles	# Kept	Notes
"child care" | "infant care" | "child daycare" | "child daycare centers" | nursery | nurseries | "nursery school" | "nursery schools" | "pre-school" | preschool | "pre-schools" | preschools | kindergarten	Whole record	1,668	1	The article was also selected from BLDS website.

DATABASE SEARCHED: POPLINE

DATE: March 22, 2010

LIMITS:

Search Term Syntax Used	Fields searched	# Articles	# Kept	Notes
child care / infant care / child daycare / child daycare centres /	Title, abstract and	1,484	0	

nursery / nurseries / nursery school / nursery schools / pre-school / preschool / preschools / pre-schools / kindergarten	keywords			
DATABASE SEARCHED: British Library for Development Studies (BLDS)				
DATE: March 22, 2010				
LIMITS:				
Search Term Syntax Used	**Fields searched**	**# Articles**	**# Kept**	**Notes**
"Child daycare centers" OR "daycare centers"	All fields	661	2	Both articles were also selected from EconLit, IFPRI and IDEAS websites.
"Child daycare" OR "nursery"				
"nursery school" OR "nurseries"				
"Pre-school" OR "preschool"				
"Kindergarten"				
"child care" OR "infant care"				
"nursery schools" OR pre-schools				
DATABASE SEARCHED: Literatura Latinoamericana y del Caribe en Ciencias de la Salud (LILACS)				
DATE: June 23, 2010				
LIMITS:				
Search Term Syntax Used	**Fields searched**	**# Articles**	**# Kept**	**Notes**
Child AND daycare AND centers	Title and abstract words	2,093	0	
nursery OR nursery AND school				
Nurseries OR preschool OR kindergarten				
Child AND care				
Infant AND care				
child AND daycare				
nursery AND schools				
pre-school OR pre-schools OR preschools				
DATABASE SEARCHED: Google				
DATE: August 18, 2010.				
LIMITS:				
Search Term Syntax Used	**Fields searched**	**# Articles**	**# Kept**	**Notes**
"child day care centers" OR "child care" OR "infant care" OR "child day care" OR "nursery" OR "nurseries" OR "nursery school" OR "nursery schools" OR "preschool" OR "preschools" OR "kindergarten" AND "nutrition" OR "health" OR "development" AND "impact" OR "effectiveness"	Whole record	19,800,000	0	One researcher reviewed the first 500 hits.

Appendix B: Summary of excluded studies

	Reference	Country	Reason for exclusion
1	Aboud (2006)	Bangladesh	Quality: The study did not control for selection bias.
2	Aguilar and Tansini (2010)	Uruguay	Scope: The study it is not an impact evaluation of a preschool intervention. The authors estimated the effect of having attended preschool on primary school performance. Having attended preschool was only one of many explanatory variables. The models did not control for selection bias.
3	Armecin, et al. (2006)	Philippines	Scope: Daycare was only one component of a large set of interventions, including growth monitoring, IMCI, supplementation, immunization. It is not clear to what extent children were exposed to daycare or to what extent the impact might be attributable to the daycare component.
4	Arora, et al. (2007)	India	Quality: The study did not control for selection bias.
5	Behrman, et al. (2008)	Guatemala	Scope: The study is not an impact evaluation of a preschool intervention. The authors analyze the preschool experience as a determinant of adult cognitive skills.
6	Berlinski and Galiani (2007)	Argentina	Scope: The only child outcome -school enrollment- was not a key outcome of this review.
7	Cueto, et al. (2009)	Peru	Quality: The authors used propensity score matching, but used very few variables to construct the propensity score. Some key variables were missing, such as a measure of socio-economic status and paternal employment. It is not clear how the education variable was constructed ("parents with completed primary education"). In summary, it is not clear whether the matching exercise rendered the two groups comparable.
8	Das Gupta, et al. (2005)	India	Quality: The authors used matching to control for selection bias, but did not provide any details on the matching methodology[19].
9	Ghuman, et al. (2006)	Philippines	Scope: The study is not an impact evaluation study of a daycare intervention. The authors analyzed the determinants of enrollment in first grade of primary school.
10	Gultiano and King (2006)	Philippines	Scope: The authors evaluated the same program as Amercin *et al*. (2006); this study was excluded for the same reasons.
11	Gustafsson (2009)	South Africa	Type: This publication is a policy note, not an impact evaluation study.
12	Felício, et al. (2009).	Brazil	Scope: The authors did not evaluate a particular preschool intervention but evaluated attending any early childhood education in a municipality in Brazil.

[19] The authors were contacted but they did not have a document with all the analytical details that they could share.

	Reference	Country	Reason for exclusion
13	Flores Hernández, et al. (1999)	Mexico	Quality: The treatment group was significantly worse off than the control group in terms of economic status and educational level. These differences were not controlled for in the multivariate analysis. Being worse off should result in more respiratory infections, which means that the true effect (kids in daycare having more infections) could be underestimated. On the other hand, parents with higher levels of education are known to report more illnesses, as they are more aware. This could have led to an underestimation of the effect. Neither of these effects were discussed or controlled for.
14	Jaramillo and Tietjen (2001)	Guinea & Cape Verde	Quality: Authors use OLS and claim –based on a low inverse Mills ratio- that selection bias is unlikely. It is not clear how this ratio was computed. Additionally, the control group was significantly different from the preschool group on a number of key characteristics (mother working outside the home, maternal literacy, mother being the head of household and household SES).
15	Johnes (2008)	India	Scope: Dependant variable was not relevant for the review (educational participation).
16	Kagitcibasi, et al. (2001)	Turkey	Quality: The study did not control for selection bias.
17	Pandey (1991)	India	Quality: Children were matched, but it is not clear how.
18	Lordelo, et al. (2007)	Brazil	Quality: There is no evidence in the article that the groups were comparable and it is not clear whether the analyses controlled for any differences between groups.
19	Pérez-Escamilla and Pollitt (1995)	Colombia	Scope: The main focus of the program was malnourished children. Additionally, the youngest age of enrollment was 4.2 years; our review focuses on children <5 years of age.
20	Raizada, et al. (1993)	India	Quality: The study did not control for selection bias.
21	Rao and Sharma (2004)	India	Paper could not be found.
22	Raudenbush, et al. (1991)	Thailand	Quality: This study presents a retrospective comparison of students who were exposed to daycare and students who were not. There was no evaluation of selection bias.
23	Rodrigues, et al. (2010)	Brazil	Quality: Insufficient details on the intervention and the sample of analysis. Treatment variable (including starting age of preschool) and other covariates self reported by children in 4^{th} grade.
24	Silva, et al. (2000)	Brazil	Quality: The study did not control for selection bias.
25	Vazir and Kashinath (1999)	India	Paper could not be found.
26	World Bank (2001)	Brazil	Type: Not an impact evaluation study but a policy paper. The results of another impact evaluation study are reported; the referenced document was requested but no answer was received.
27	Zaitune Curi and Menezes-Filho (2006)	Brazil	Quality: The analyses did not control for selection bias.

Reference list of excluded studies

Aboud, F.E. (2006) Evaluation of an early childhood preschool program in rural Bangladesh. Early Childhood Research Quarterly, 21(1), pp. 46–60.

Aguilar, R. and Tansini, R. (2010) Pre-School Education and School Performance The Case of Public Schools in Montevideo. Working Papers in Economics, No. 434, University of Gothenburg.

Armecin, G., Behrman, J.R., Duazo, P., Ghuman, S., Gultiano, S., King, E. and Lee, N. (2006) Early Childhood Development through an Integrated Program: Evidence from the Philippines. Policy Research Working Paper, No.3922, World Bank, Washington, D.C.

Arora, S., Bharti, S., and Sharma, S. (2007) Comparative study of cognitive development of ICDS and non-ICDS children (3–6 years). Journal of Human Ecology, 22(3), pp. 201–204.

Behrman, J.R., Hoddinott, J., Maluccio, J.A., Soler-Hampejsek, E., Behrman, E.L., Martorell, R., Ramirez-Zea, M. and Stein, A.D. (2008) What determines adult cognitive skills? Impacts of pre-school, school-years and post-school experiences in Guatemala. IFPRI Discussion Paper, No. 00826, Washington, D.C.

Berlinski, S. and Galiani, S. (2007) The effect of a large expansion of pre-primary school facilities on preschool attendance and maternal employment. Labour Economics, 14(3), pp. 665–680.

Cueto, S., Guerrero, G., Leon, J., Zevallos, A. and Sugimaru, C. (2009) Promoting early childhood development through a public programme: wawa wasi in Peru. Working paper, No. 51, Young lives project, Department of International Development, University of Oxford, UK.

Das Gupta, M., Lokshin, M., Gragnolati, M. and Ivaschenko, O. (2005) Improving Child Nutrition? The Integrated Child Development Services in India. Development and Change, 36(4), pp. 613-640.

Ghuman, S., Behrman, J., Gultiano, S. and King, E. (2006) Children's nutrition, school quality, and primary school enrollment in the Philippines. Popul Council, New York, NY.

Gultiano, A.S. and King, E.M. (2006) A Better Start in Life: Evaluation Results from an Early Childhood Development Program. Philippine Journal of Development, 33(1-2), pp. 101-128.

Gustafsson, M. (2009) Policy note on pre-primary schooling: An empirical contribution to the 2009 Medium Term Strategic Framework. Stellenbosch Economic Working Papers, No. 05/10, University of Stellenbosch, South Africa.

Felício, F.R., Terra de Menezes, R. and Zoghbi, A.C. (2009) The effects of early childhood education on literacy scores using data from a new Brazilian assessment tool, Working paper presented at the XXXVII National Meeting of Economics, ANPEC, Foz do Iguaçú (Brazil).

Flores Hernández, S., Reyes Morales, H. and Pérez Cuevas, R. (1999) The Day Care Center As a Risk Factor for Acute Respiratory Infections. Archives of Medical Research, 30(3), pp. 216–223.

Jaramillo, A. and Tietjen, K. (2001) Early Childhood Development in Africa: Can We Do More for Less? A Look at the Impact and Implications of Preschools in Cape Verde and Guinea, Africa Region Human Development, Working Paper Series, World Bank, Washington, D.C.

Johnes, G. (2008) Early year education and subsequent schooling in rural india: an economic analysis. Working paper 018, Lancaster University Management School.

Kagitcibasi C., Sunar D., Bekman S. (2001) Long-term effects of early intervention: Turkish low-income mothers and children. J Appl Dev Psychol, 22(4), pp. 333–61.

Pandey, H. (1991) Impact of preschool education component in Integrated Child Development Services programme on the cognitive development of children. J Trop Pediatr, 37(5) pp. 235-239.

Lordelo, E.R., Chalhub, A.A., Guirra, R.C. and Carvalho, C.S. (2007) Contexto e Desenvolvimento Cognitivo: Freqüência à Creche e Evolução do Desenvolvimento Mental. Psicologia: Reflexão e Crítica, 20(2), pp. 324-334.

Perez-Escamilla, R. and Pollitt, E. (1995) Growth improvements in children above 3 years of age: the Cali Study. J Nutr., 125(4), pp. 885-893.

Raizada, N., Sachar, R.K., Bhatia, R.C., Sehgal, R. and Soni, R.K. (1993) The impact of preschool education component of ICDS on mental and cognitive development of children', Indian J Matern Child Health, 4(1), pp. 4-8.

Rao, N. and Sharma, A. (2004) The impact of the integrated child development services program on the development of young children in India.

Raudenbush, S., Kichanapanish, S. & Jin Kang, S. (1991) The Effects of Preprimary Access and Quality on Educational Achievement in Thailand. Comparative Education Review, 35(2), pp. 255-273.

Rodrigues, C.G., Pinto, C.X.C. & Santos, D.D. (2010) The impact of daycare attendance on Math test scores for a cohort of 4th graders in Brazil. Draft research paper.

Silva, E.M, Miranda, C.T., Puccini, R.F., Nóbrega, F.J. (2000) Day care centers as an institution for health promotion among needy children: an analytical study in Sao Paulo, Brazil. Public Health, 114(5), pp.385-388.

Vazir, S. and Kashinath, K. (1999) Influence of the ICDS on psychosocial development of rural children in Southern India. J Indian Acad Appl Psychol, 25(1-2), pp. 11–24.

World Bank (2001) Brazil - Early child development - a focus on the impact of preschools. Sector Report, No. 22841, Washington, D.C.

Zaitune Curi, A. and Menezes-Filho, N.A. (2006) Os Efeitos Da Pré-Escola Sobre Os Salários, in: Anais do

XXXIV Encontro Nacional de Economia [Proceedings of the 34th Brazilian Economics Meeting] from

ANPEC - Associação Nacional dos Centros de Pósgraduação em Economia [Brazilian Association of

Graduate Programs in Economics].

Appendix C: Detailed summary of included studies

Table C.1 Detailed summary of included studies

Country *Reference*	Intervention	Sample characteristics	Evaluation design and analytic method	Study quality assessment
Colombia Attanasio et al. (2010)	*Hogares Comunitarios de Bienestar (HCB)*. *Madres comunitarias* provide childcare in their homes for a small fee to groups of up to 15 children 0 to 6 y. Care includes lunch, 2 snacks and a nutritional beverage (70% of caloric needs) **Eligibility criteria:** households with children 0 to 6 y belonging to SISBEN levels 1 to 2 (SISBEN is an indicator of economic well-being; indicator ranges from 1 (poorest) to 6).	**Data: Rural areas: T**hree pooled rounds of panel data (2002, 2003, 2005-2006). Data collected to evaluate *Familias en Acción (FeA)* program in rural areas; only control communities considered here. Urban areas: the *Encuesta Nacional de Demografía y Salud (ENDS)*, nationally representative household survey (2005). **Age:** 0-6 y **N:** Rural (FeA) round 1: 2345, round 2: 2395, round 3: 966. Urban (ENDS): 6170 (for exposure) and 6189 (for attendance). Not clear how many kids were excluded from the analyses.	**Treatment**: current attendance and exposure to HCB (fraction of life spent in HCB) **Outcomes**: Child height (HAZ) **Analyses**: IV regression, using three instruments in rural areas (distance of household to nearest HCB, median fee paid by children to attend a HCB in the locality, and number of places available in a given municipality relative to the eligible population (capacity)) and one instrument in urban areas (capacity). Overall impact and impact by child height quintiles.	•The FeA sample only includes SISBEN 1 households; •Not clear how many children were excluded from the analyses; •Effect sizes are biologically implausible; •Unlikely that program effect is linear with respect to exposure (i.e. proportion of the child's life spent in daycare); •Not clear how 3 rounds of panel data were modeled.

Country *Reference*	Intervention	Sample characteristics	Evaluation design and analytic method	Study quality assessment
Colombia Bernal *et al*. (2009)	Hogares Comunitarios de Bienestar (HCB). Madres comunitarias (MC) provide childcare in their homes for a small monthly fee (3.5 USD/mo in 2008) to groups from 12 to 14 children 0 to 6 y. Care includes lunch and snacks (50% to 70% of caloric and nutritional needs). There are two modalities full time or part time. MC must have at least 9 years of schooling and have to attend training sessions provided by government. 92% of HCB have the characteristics mentioned above. The rest provide services to a larger number of children with additional staff (not in a private home). HCB also provides: growth monitoring, health promotion and disease prevention and activities to promote socio-emotional and cognitive development. Eligibility criteria: households with children 0 to 6 y belonging to SISBEN[20] levels 1 to 2.	**Data:** X-sectional (Feb-Jul 2007). Treatment group from a random sample of HCB; control group through visiting neighboring households not participating in the *Familias en Acción* program with SISBEN 1-2 (choice based sample). X-sectional (2005) for medium term outcomes: Test scores of children at 5th grade provided by ICFES[21] and socioeconomic profile of their families collected with a survey. **Age:** 0-6 y **N:** Full sample 26,254 (49% treatment group) in 1100 HCB (937 full time, 163 part time). Subsample of 6,150 children 3 to 6 y (50% treatment) in 409 HCB for some child development outcomes (Peabody, WJM, PIPPS). 1,890 eligible children with test scores at 5th grade (49.8% attended a HCB when they were 0-6y)	**Treatment**: 1) a. attendance, b. <1, 2-4, 5-15 and 16+ mo of attendance; 2) months of exposure to the program (≤ 1 mo vs > 1mo). **Outcomes**: stunting (HAZ<-2SD), underweight (WAZ<-2SD) and wasting (WHZ<-SD); diarrhea, acute respiratory infections (ARI), complete vaccination scheme; Early Development Instrument (EDI), Penn Interactive Peer Play Scale (PIPPS): Peabody Picture Vocabulary Test (Peabody), Woodcock Johnson-Muñoz (WJM); and test scores in 5th grade.[22] **Analyses**: PSM (kernel), matching 1) a. treatment to control; b. <1, 2-4, 5-15 and 16+ mo to control) 2) treatment with ≤ 1 mo of exposure to treatment with > 1mo of exposure. Heterogeneous effects by HCB and MC characteristics, using PSM and attendance as treatment variable. Medium term impact of the program on test scores in 5th grade, using instrumental variables (the availability of places in HCB at the municipality level per 1000 poor inhabitants).	• Matched treatment- control estimates suffer from selection bias • Not clear how subsample was selected; • Relatively low prevalence of malnutrition, so potential to benefit is low; • Positive effect on diarrhea and ARI might be due to an increase in morbidity in children just after joining daycare

[20] SISBEN: Identification System of Potential Beneficiaries of Social Programs (*Sistema de Identificación de Potenciales Beneficiarios de Programas Sociales*)

[21] ICFES: Colombian Institute for Evaluation of Education (*Instituto Colombiano para la Evaluación de la Educación*)

[22] **Early Development Instrument (EDI):** caregiver's (the mother in this case) perception of the psychosocial development of the child (range: 1 to 3; lower score indicates fewer behavior problems). **Penn Interactive Peer Play Scale (PIPPS)**: maternal report in the control group and *madres comunitarias'* report of children in the treatment group, about child social conduct during play time (range: 1 to 4). **EDI cognitive**: maternal report of the cognitive development of her child (range: 0 to 1; lower score is better). **Peabody Picture Vocabulary Test**: scale of verbal skills directly applied to children (scale range 55 to 145, larger is better. Population level mean (SD)=100(15)). **Woodcock Johnson-Muñoz (WJM):** test of intellectual ability, verbal ability, mathematical reasoning and general knowledge applied directly to children (standardized scores for age, larger numbers are better. Population level mean (SD)=100(15)).

Country *Reference*	Intervention	Sample characteristics	Evaluation design and analytic method	Study quality assessment
Bolivia Behrman et al. (2004)	*Programa Integral de Desarrollo Infantil (PIDI)* Childcare in homes of women in low-income areas; up to 15 children per PIDI, 1 staff/5 children. Food provided (70% of nutritional needs), health and nutrition monitoring and educational activities. Full time, no fees charged **Eligibility criteria[23]:** Children 6-72 mo, poor urban areas, household eligibility evaluated using an index based on housing characteristics and working status	**Data:** Repeated x-sections (11/95-05/96 and 11/97-05/98) of (a) participating children; (b) non-participating children living close to PIDI; (c) children in poor urban areas not served by PIDI. **Age**: 6-72mo **N:** (a) ? (out of 3618), (b) ? (out of a total of 3432, of which 1545 eligible) and (c) ? (out of a total of 2360, of which 1296 eligible).	**Treatment**: attendance, cumulative impact (1-6, 7-12, 13-18, 19-24 and 25+ mo), ≤1 mo *vs.* ≥2 mo **Outcomes**: HA%, WA%, bulk motor, fine motor, language and auditory, and psycho-social skills. **Analyses**: matching children from sample (a) to children who meet the eligibility criteria in (b) and (c)	Not clear how many children were excluded from the analyses;
Guatemala Ruel et al. (2006)	*Hogares Comunitarios (HC)* Daycare provided by women in the community to up to 10 children 0 to 7 y of age Monday to Friday from 6 a.m. to 6 p.m. Care includes breakfast, lunch, and 2 snacks (80% of nutrient requirements); psycho-pedagogical activities, general care and hygiene. **Eligibility criteria:** Children 2 to 7 y, mothers working outside the home, 1 urban zone in Guatemala City.	**Data:** Cross-sectional beneficiary (random sample of beneficiaries from 1 urban zone in Guatemala City) & control (individually matched children based on age +/-3 mo, gender, maternal employment, and neighborhood of residence) **Age:** 2-5 y **N:** 255 control and 250 treatment (out of 518 children, 259 pairs)	**Treatment:** attending daycare **Outcomes:** percentage of child daily energy and nutrient requirements (protein, Ca, Fe, Vit C, Vit A, Zn) **Analyses**: matching by design (at the time of subject selection), propensity score matching (PSM, nearest neighbor (NN) and kernel)	Not clear to what extent limiting the PSM to the common support affected the internal validity of the results
Argentina Berlinski et al. (2009)	Expansion of public pre-primary school provision (through construction of classrooms) from 93-99. Pre-primary for children 3 to 5, 3.5 hrs / day, two shifts (am and pm), 5 days a week, 9 mo school year. Class size: 25 children. **Eligibility criteria**: Children 3 to 5y. Last year of pre-primary school compulsory since 1993.	**Data:** Argentine household survey, 1994-2000 & *Operativo Nacional de Evaluación Educativa* rounds 1995 through 1999 **Age:** 3rd graders **N:** mathematics 126,106 (out of ?), Spanish 177,515 (out of?), students behavior reported by teachers: 4540 to 4586 (out of ?)	**Treatment:** supply of pre-primary schools, attending pre-primary school. **Outcomes:** Spanish and mathematics test scores; teachers' perception of student behavior (attention, effort, class participation, discipline) **Analyses:** Retrospective. Used exogenous increase in pre-primary school availability (construction of 3724 classrooms from 93-99) as treatment variable; interacted with child gender and municipality specific poverty level to estimate effect modification.	Not clear how many children were excluded from the analyses;

[23] Eligibility criteria changed. The latest criteria are reported here. The original criteria included child malnutirition (no objective measure was used to verify it).

Country ***Reference***	**Intervention**	**Sample characteristics**	**Evaluation design and analytic method**	**Study quality assessment**
Uruguay Berlinski et al. (2008)	Expansion of public pre-primary school classrooms from 1995-2002. Pre-primary services for 3 to 5 y olds; 4 hrs/day, two shifts (am and pm), 5 days a week during 180 day school term. **Eligibility criteria**: Children 3-5y. Pre-primary school is compulsory for children 4 to 5 y.	**Data:** *Encuesta Continua de Hogares* (representative household survey), rounds 2001-2005 with retrospective information on years of preschool completed. Analyses restricted to children in 2 parent families where all children are children of the head of the household. **Age:** 7 to 15 y **N:** 23,042 (out of ?)	**Treatment:** attended <1 y *vs.* ≥1 y, ≥2 *vs.* 1 and 3 *vs.* 2 y of preschool **Outcomes**: school attendance, years of schooling. **Analyses**: within household estimator, using variability between siblings and controlling for birth order, sex, mother´s age and education, living in Montevideo or not, household fixed effects. Additionally, preschool attendance instrumented with average locality and cohort-specific attendance rates.	•Not clear how many children were excluded from the analyses; •No gender specific attendance and grade progression descriptive statistics provided, so impossible to evaluate to what extent the difference in effects by maternal education and location are due to preexisting differences; •Not clear whether households with between sibling variability are different than average beneficiary households.

Contacts

International Initiative for Impact Evaluation (3ie)
www.3ieimpact.org | 3ie@3ieimpact.org

New Delhi: +91 11 2613 9494/6885 | London: +44 207 958 8351/8350
Washington: +1 202 629 3939