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Evaluating the Impact of the Healthy Beginnings System of Care on Pediatric Emergency Department Utilization

By

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Master of Public Health

Epidemiology

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Evaluating the Impact of the Healthy Beginnings System of Care on Pediatric Emergency Department Utilization

By
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Bachelor of Science in Chemistry and Economics
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2007

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Abstract

Evaluating the Impact of the Healthy Beginnings System of Care on Pediatric Emergency Department Utilization

By Cheryl H Tan

Objective

To evaluate whether enrollment in the Healthy Beginnings System of Care (SOC) is associated with a decrease in total emergency department (ED) visits among children aged 6 months to 5.5 years.

Methods

This is a retrospective, longitudinal study of ED utilization among children enrolled in the Healthy Beginnings SOC between February 2011 and May 2013. The SOC employs a Health Navigator who works with low income families to improve healthcare access through connecting them with health insurance and primary care physicians, making referrals for health or developmental concerns, and providing health education (e.g. well-child visits and immunizations). Using ED medical records obtained from a local children's hospital, total ED visits per quarter was examined as the main outcome. A multi-level, multivariate Poisson model, with family- and child-level random effects to control for correlation, was used to calculate the effect of enrollment on the rate of ED utilization for children enrolled in the SOC. Adjusted rate ratios (aIRR) and 95% confidence intervals were calculated after controlling for confounders such as child's age, enrollment age and parent's income.

Results

The effect of SOC enrollment on the rate of ED visits differed by income level of the primary parent. Adjusting for confounders, the rate of ED visits post-enrollment was not significantly different than the rate of ED visits pre-enrollment for children whose primary parent's annual income was under $5,000 (aIRR= 1.12, 95% CI: 0.90 - 1.40), for children whose primary parent's annual income was $20,000-$29,999 (aIRR = 1.36, 95% CI: 0.85 – 2.16), and for children whose primary parent's annual income was $30,000 and over (aIRR = 0.55, 95% CI: 0.26 – 1.17). However, for the children whose primary parent's annual income was $5,000 to $19,999, the rate of ED visits post-enrollment was significantly higher compared to the rate of ED visits pre-enrollment (aIRR = 1.48, 95% CI: 1.17 – 1.87).

Conclusion

Enrollment does not appear to decrease the rate of ED visits among children in the Healthy Beginnings SOC. Additional strategies, such as specific education sessions on ED utilization, are needed by the SOC to reduce the rate of ED utilization among enrolled children.

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Introduction

In 2007, children under the age of 18 had an estimated rate of 361.5 Pediatric Emergency Department (PED) visits per 1,000, and these rates were even higher among children on Medicaid insurance (561.7 per 1,000) [1]. Based on a 2005 study in selected states, five out of the top six reasons for visiting the Emergency Department (ED) among children include non-urgent conditions such as upper respiratory infections, superficial injuries, ear infections, sprains/strains and fever [2]. In fact, only 4.0% of all pediatric ED visits resulted in hospital admission in 2010 [3], suggesting high levels of non-urgent ED use among children.

A non-urgent condition is "neither life nor limb threatening nor time sensitive and therefore amenable to care in a private office or public clinic" [4]. As such, the decision to visit the ED for a non-urgent condition is detrimental to both providers and patients. From the provider's perspective, non-urgent ED utilization represents an inefficient allocation of hospital staff and resources and can often result in higher ED operational costs [5]. From the patient's perspective, non-urgent ED visits are costly in terms of time, money, and potential health impact. Specifically, non-urgent ED visits can lead to overcrowded EDs that translate into longer wait times for patients [6]. Also, for a given non-urgent condition, patients end up paying more for an ED visit compared to what they would have paid at a doctor's office [5]. Lastly, using the ED as opposed to a primary care physician for non-urgent care deprives the patient of a continuous source of primary care [7] and this lack of continuity of care is associated with poorer health outcomes [8]. The high prevalence among children, as well as its negative impacts, justifies efforts to understand and reduce the rate of non-urgent pediatric ED utilization.

Background and Literature Review

Factors associated with non-urgent pediatric ED utilization

Numerous studies [7-31] have examined the factors associated with non-urgent pediatric ED utilization. Factors proposed include the child's demographic and socio-economic context [7-17], caregiver's literacy regarding PED usage [11, 13, 18-24], and the characteristics of primary care practices/PEDs that provide services to these families [13, 16, 18-22, 24, 26-31]. Each of these will be discussed in more detail below.

Demographic and Socio-Economic Context

Several child attributes and family characteristics are associated with higher non-urgent PED use. Specifically, older children (11-12 year olds) were more likely to use the PED for a non-urgent condition compared to children aged 0-2 [9]. Other studies found that higher non-urgent PED use was associated with a child being black [7, 9], Native American [10] or Hispanic [11]. Furthermore, family characteristics such as having low household income [12] or belonging to a single parent household [11] were reported as being predictors of non-urgent PED.

Lower healthcare access is also a predictor of higher non-urgent PED use. Numerous studies indicate that not having a primary care physician or a regular source of care was associated with higher non-urgent PED visits [8, 10, 13-15]. One study found that improved primary care access through enrollment in a Medicaid managed care plan was associated with lower non-urgent PED visits [4]. However, there are inconsistent findings among studies that compare privately- and publically-insured children. One study found higher PED use among privately-insured children [10], while another found higher PED use among publicly-insured children [16], and yet another found no significant differences between the two groups [17]. These discrepancies are likely due to different study

populations - Johnson studied children in a rural border community [10], Chande examined children visiting an urban PED [16], and Luo used a nationally-representative dataset of US non-institutionalized children [17].

Caregiver Health Literacy

There have been several studies examining the reasons behind an adult caregiver choosing a PED over a primary care physician for their child's non-urgent conditions. Many caregivers, who bring their children into the PED for a non-urgent condition, incorrectly assess their child's condition as a true emergency [11, 13, 18-22]. Caregivers who perceive their child's general health as poor were also more likely to have a non-urgent PED visit [11, 23]. Some caregivers visit the PED despite receiving advice from their primary care physicians about the non-urgent nature of their child's condition, because they desire a second opinion [21, 24]. Other caregiver reasons for using the PED for a non-urgent condition include: caregiver's familiarity with visiting the ED for their own care [12, 25] and lack of knowledge about services covered by insurance [18].

Primary Care Physician and PED Characteristics

There are several factors associated with primary care physicians (PCP) that may influence caregivers towards using the PED for non-urgent care. Caregivers cite limited access to their PCP due lack of appointment times or the PCP being closed outside of regular business hours [16, 18, 19, 21, 22, 26] as reasons for choosing the PED. Another reason is dissatisfaction with PCPs because of long wait times [27-29], low quality care [22, 29, 30] or difficulty communicating with their PCP [27]. Caregivers are also being referred by their PCPs to visit the PED for non-urgent conditions [13, 18, 27, 31]. Such referrals might be because PCPs prefer to trust parental instincts rather than be wrong about the illness [24]

or simply because the PCPs have a schedule too full to accommodate a late afternoon appointment [13].

In addition to these PCP factors, there are several features of the PED that may make it preferable for caregivers to use when their children are in need of non-urgent care. Round the clock availability, closer proximity [7] and the presence of multiple services under one roof [27] make PEDs more convenient, and hence the preferred venue for non-urgent care, compared to PCPs [13, 18, 20, 27, 31]. Caregivers may also choose the PED over their PCP because they believe that the PED has a higher quality of care and a more competent staff [20-22, 26, 27]. Lastly, caregivers may believe that the PED has better resources and can conduct better diagnostic testing than their PCP, regardless of whether their child needs such tests [19, 21, 24, 27].

Interventions to reduce non-urgent pediatric ED visits

Given the extent and complexity of non-urgent PED visits, several interventions [32-40] have been developed to address these types of visits. The effectiveness of these interventions were typically assessed by measuring the decrease in total PED visits [32-34, 36-38] or decrease in non-urgent PED visits [35, 39, 40]. Interventions fell into two broad categories, educational interventions and case management strategies, and are discussed in more detail below.

Educational Interventions

Educational interventions were either conducted generally among families [32-34] or specifically targeted at families who had a history of visiting the PED for non-urgent reasons [35, 36].

One type of educational intervention involved developing verbal guidelines or training programs to reduce future non-urgent ED use. Fieldston et al conducted an educational

activity at primary care clinics teaching caregivers how to manage non-urgent conditions at home, but found no subsequent decrease in PED use six months after the intervention [32]. Chande et al conducted health promotion training among parents of infants who visited the PED for a non-urgent condition, educating them on the role of a PCP and the importance of PCP continuous care, as well as setting up follow-up visit with their PCP [35]. However, this intervention did not appear to change either PCP or ED utilization patterns [35]. Racine et al conducted a randomized control intervention trial among patients presenting at the PED, to study the effects of a follow-up phone call from a primary care practice soon after an ED visit [36]. ED patients randomized to receive the intervention received a phone call from their PCP office inquiring about post-visit patient status, providing advice about appropriate use of the PED, informing parents of after-hours phone availability and setting up a follow-up PCP visit if necessary [36]. Results did not indicate a difference between intervention and control groups in terms of visiting the ED after an initial PED visit [36].

Educational interventions which involved developing appropriate reading materials appear to be more effective. Herman et al developed reading materials and conducted training to teach caregivers how to handle situations in which their child expressed a non-urgent complaint [33]. Yoffe et al also developed a reading level appropriate booklet to help caregivers better care for children experiencing a non-urgent condition [34]. Both these interventions were associated with a reduction in the number of reported ED visits [33] or number of non-urgent ED visits [34].

Case Management

A case management intervention comprises healthcare staff working closely with families to improve utilization of primary care physicians and decrease non-urgent PED utilization. Case management interventions involve continued contact with families rather than a single interaction with intervention staff, distinguishing them from some of the educational interventions described in the previous section.

Case management interventions can involve a gatekeeper model where children must be referred by their primary care physician to visit the ED. One such intervention that involved setting up 24-hour access to an on-call PCP who referred children to a PED for appropriate conditions, found a significant decrease in overall and non-urgent ED use in the two months following the intervention [37]. Another similar intervention among children on Medicaid involved increasing PCP access and educating families about the importance of a medical home in addition to requiring referrals before admission to the PED [38]. This intervention reported significant decreases in overall PED use in the twelve month period after the start of the program [38]. Both interventions were conducted generally among families with children.

Case management interventions that did not involve a gatekeeper also demonstrated reductions in non-urgent or overall PED use. Grossman et al compared one group of families who received education about the importance of a PCP as well as assistance with scheduling a PCP visit, to an intervention group who received follow-up by a study employee in addition to the education and scheduling assistance [39]. The follow-up lasted up to three months and involved dedicated a study employee helping intervention families overcome barriers associated with utilization of primary care [39]. Compared to the first group, the intervention group had fewer non-urgent ED visits in the initial six months, but

no significant differences in the subsequent months [39]. Ross et al also conducted an intervention for families with frequent ED visits, focusing on education, follow-up and collaboration with PCP and other healthcare service providers [40]. Families also received counseling and training in skills like prioritization, communication and problem solving for six to ten months [40]. Results indicated significant decreases in the ED visits for the intervention group compared to the control group [40]. Both interventions were targeted at families with a history of non-urgent ED use.

Background on Healthy Beginnings System of Care

The *Healthy Beginnings* collaborative is also a case management intervention involving a Health Navigator (HN) who works closely with families who are part of Educare Atlanta Early Childhood Center, located in Atlanta's Neighborhood Planning Unit-V (NPU-V). The goals of the collaborative are to ensure that children are "healthy, developing on track, and thriving socially and emotionally, to achieve academic success" [41]. Started in January 2011, the collaborative developed a System of Care (SOC) that provides high-impact health supports for young children (birth to Pre-K) and their families through a community-based, coordinated care approach. As part of this approach, the SOC cooperates with a diverse set of community partners including Children's Healthcare of Atlanta, Georgia Department of Health and Atlanta Public Schools.

The SOC differs from educational interventions because it takes a more holistic approach of ensuring that parents find a PCP, sign up for health insurance, and get referrals for various health and developmental concerns, in addition to providing general health information. The HN also works with families for a longer duration, particularly if siblings are enrolled in the SOC, distinguishing it from some of the case management interventions which last for less than a year. Furthermore, the SOC is distinct from other interventions in

that it focusses on low income families and in that it does not specifically target frequent PED users. Given the differences between the SOC and other interventions, understanding the impact of SOC enrollment on PED use is valuable.

Methods

Study Objective

The primary objective of this study was to evaluate whether enrollment in the Healthy Beginnings SOC is associated with a decrease in total ED visits among children aged 6 months to 5.5 years (pre-K). A secondary objective of the study was to understand whether the effect of SOC enrollment on ED utilization differs by child's age at enrollment and by child's medical conditions (e.g. asthma).

Study Population

The study is a retrospective, longitudinal study of emergency department utilization among children who have ever been enrolled in the Healthy Beginnings SOC. This population of interest consisted of 305 children who were enrolled between February 2011 (program inception) and May 2013. Among these children, parents who stated at enrollment that they would use any one of three Children's Healthcare of Atlanta (CHOA) emergency departments (Hugh Spalding, Egleston, Scottish Rite) as their child's primary ED were included in the study. Only 26 (8.5%) children who listed some other primary ED site were excluded from the study at this stage.

The names, dates of births, and medical record numbers (where possible) of the 279 included children were submitted to CHOA in order to abstract ED records. Seventeen children for whom a CHOA medical record of any type could not be found were also excluded. A total of 250 children had a CHOA ED record, with 222 of them having an ED visit within the period of interest from 1 July 2009 to 31 March 2013 and being of the appropriate age (6 months – 5.5 years) at the time of visit. The other 28 children for whom a CHOA ED record was found, either had an ED visit outside of the period of interest or

only had visits when they were too young (<6 months) or too old (>5.5 years). The remaining 12 children did not have an ED record but had outpatient, specialist or other types of CHOA records. **Figure 1** provides a summary of the selection process.

The seventeen excluded children, whose CHOA medical record could not be found even though they listed one of the three CHOA sites as their primary ED, were compared to the children included in the study (**Appendix A**). Comparisons revealed few significant differences in demographic, socioeconomic and health characteristics between the two populations. The excluded children differed significantly from the study population in terms of zip code at enrollment, marital status of primary parent, and income of primary parent. There were no significant differences in the medical conditions reported at enrollment between the two groups of children.

Emory's Institutional Review Board (IRB) determined that the study was IRB-exempt because the emergency department records and Healthy Beginnings SOC data were collected for non-research related purposes of evaluating the work of the Health Navigator and impact of the SOC. This exempt determination was accepted by CHOA's IRB. Although IRB did not require informed consent for the study, parents signed consents when they enrolled in the SOC to allow persons working with the SOC to access and view their child's health records. The study is being conducted under the authority and approval of the Healthy Beginnings SOC Director.

Healthy Beginnings SOC Program

Children were enrolled into the Healthy Beginnings SOC on a rolling basis starting in February 2011, with larger numbers enrolling in the months of June, July and August. SOC families work with a Health Navigator, a CHOA registered nurse based in the Educare Atlanta center, on an ongoing basis. At enrollment, the HN: a) provides an overview of the

SOC; b) collects demographic and health information about the child; c) connects children and their families to health insurance and primary care physicians (PCP); d) identifies other health needs and makes appropriate referrals; and e) provides health information (e.g., immunization schedule or well-child visit schedules) [41]. A 2012 evaluation [41] revealed that 39% of health navigator visits fell into the Developmental Screenings activity category, where parents obtain referrals for early intervention or special education services. All these activities aim to improve access to health care, in particular primary care utilization. It is hypothesized that these improvements in access to healthcare can lead to reduced nonurgent ED utilization.

Data Collection

The data for this study came from two sources: 1) Healthy Beginnings SOC Database and 2) CHOA medical records. The Healthy Beginnings SOC Database is a Microsoft Access Database created for the purpose of capturing information on the SOC children and families, as well as for tracking their HN interactions. Information from paper forms are manually entered into the database by the SOC data administrator. This database provided demographic information on the children and parents, health information on the children and socioeconomic information on the parents. Demographic data from the database was checked for completeness and missing data was populated by checking the original paper forms. Other missing health or socioeconomic data was assumed to be missing at random. Additionally, the data was also checked to confirm siblings, dates of enrollment and dates of birth. The errors found were corrected after reviewing the original paper forms.

ED utilization data amongst SOC children were obtained directly from CHOA medical records. In May 2013, names and dates of births of the 279 identified children were

submitted to the Business Intelligence Team at CHOA as part of a data request to generate electronic reports on the children's ED visits at Hugh-Spalding, Egleston and Scottish Rite. However, CHOA was only able to find a fraction of the children using names and dates of birth. In November 2013, ChartMaxx (software for querying individuals' CHOA medical records) was used to obtain the medical record numbers (MRN) of children initially not found by CHOA; these MRNs were submitted in hopes of finding more ED records. In December 2013, CHOA provided an initial report that contained ED records for 234 of the 279 children whose names were submitted.

The remaining 45 children that were not in CHOA's reports were identified and their CHOA medical records were confirmed using ChartMaxx. Sixteen children had CHOA ED visits but were not included in CHOA's initial reports. The registration numbers for these visits were abstracted from medical charts in ChartMaxx and provided to CHOA in January 2014, allowing them to provide a supplemental report of these identified visits. The 12 children who were confirmed as having no ED visits were included in the dataset as having no ED visits, while the 17 children without any type of CHOA ED record were excluded from the dataset. Overall, 250 children had at least one ED visit at one of the three CHOA sites. From this group, 222 had ED visits within the period of interest and were of the appropriate age (6 months – 5.5 years) at the time of visit and 22 only had ED visits occurring outside the period of interest or only had ED visits when they were not of the appropriate age.

Since the SOC does not currently serve elementary-aged school kids, only ED visits in which the child was aged 6 months to 5.5 years at the time of visit were within the scope of the study. This restriction by age resulted in a total of 1,014 relevant ED visits contributed by the 222 children during the period of interest from 1 Jul 2009 to 31 Mar 2013. The ED

visit report included visit characteristics such as arrival time and mode, final diagnoses, procedure codes, insurance used and visit cost. The CHOA ED visit data was matched to the information from the SOC database using names and dates of births, but the final combined dataset had these personal identifiers removed to protect privacy.

Data Measures

The outcome of interest for this study is ED visits and was measured as a count of overall ED visits per quarter. Measuring overall ED visits, as opposed to non-urgent visits alone, was a strategy also employed by other interventions aimed at reducing non-urgent ED use [32-34, 36-38]. Seasonality in ED visits was checked and accounted for when deciding quarter cut-off dates. The primary exposure variable is enrollment in the SOC, coded as a binary variable. A child was coded as enrolled for that quarter if he/she enrolled before the middle of that quarter.

The potential covariates considered for the analysis include child-level characteristics as well as family level characteristics. The time-varying child level characteristics include age and family size. Age was determined at the middle of the quarter, using a similar strategy as enrollment status. The time-invariant child-level characteristics include gender, zip code at enrollment, birth order, prenatal care status, premature birth status, and reported significant medical conditions at enrollment. Specifically, the analysis considered the medical conditions most common for the children: asthma/ respiratory conditions, skin conditions and allergies. Birth order was coded based on children who have ever enrolled in the SOC, meaning that if the child had an older sibling that was not enrolled in the program, they would be coded as having a birth order of 1 even though they are not the oldest in the family. The family level characteristics were measured at the child's enrollment and hence are time-invariant. They include primary parent's age, marital status, employment status, income level and educational

attainment. Siblings can have the same family characteristics if enrolled at the same time, but they may also have different family characteristics if they enrolled in the SOC at different times. **Table 1** summarizes the outcome, exposure and covariates that were considered for the study.

Data Analysis

Descriptive frequencies were obtained to understand child and family-level characteristics of the study population. Additionally, the mean number of ED visits per quarter and non-urgent ED visits per quarter was also determined. Current Procedural Terminology (CPT) codes were used to determine non-urgent ED visits [39], identifying non-urgent ED visits as visits which did not receive a code associated with a high severity presenting problem (i.e. not having CPT codes 99285 or 99284) (**Appendix B**). Counts and proportions were reported for categorical variables and means and standard deviations were reported for continuous variables.

Additional descriptive frequencies were obtained to profile ED visits made between June 2009 and March 2013 by SOC children who were aged 0.5-5.5 at the time of visit. Variables considered for the ED visit profile include age at visit, visit costs, insurance used, arrival time and mode, severity of problem and diagnoses based on recorded primary ICD 9 codes. In addition to reporting counts and proportions or means and standard deviations, chi-squared tests of independence were performed on categorical variables and two-sample t-tests (pooled variances) were conducted on continuous variables to compare visits before and after SOC-enrollment.

Next, a bivariate analysis was conducted using a Poisson regression for correlated data (Generalized Estimating Equation (GEE) Poisson model) to obtain crude (or unadjusted) rate ratios for the association between the outcome and exposure, and the

outcome and potential child- and family- level covariates. The bivariate models accounted for correlation at the child- and family- level through the inclusion of a child specific random intercept and a family specific random intercept. These analyses were used to investigate potential confounding and only variables which had a significant association at the 10% level ($p<0.10$) with the outcome were considered in the multivariate model as potential confounders and/or interaction terms.

A multi-level multivariate analysis to examine the effect of SOC enrollment on total ED visits was conducted using a GEE Poisson model with child- and family-level random effects to account for correlation. The initial model included as fixed effects the primary exposure, covariates identified in bivariate analyses and two-way interactions between these covariates and the primary exposure. The initial model was evaluated for multicollinearity using condition indices (CI>30) and Variance Decomposition Proportions (VDP>0.5), and collinear terms were removed from the model. The model was evaluated for interaction using backward elimination of interaction terms that were not significant based on Type III F-tests ($p<0.05$). Confounders were removed by hierarchical backwards elimination if they did not change the association between enrollment and outcome by more than ± 10%, resulting in the final multivariate model. Adjusted rate ratios were obtained for the primary exposure, confounders and interaction terms in the final model.

To understand the influence of a scabies outbreak that occurred at the SOC which caused an increase in ED visits in December 2012 , the multivariate analysis was repeated on data that did not include 2012 quarter four (October 1st – December 31st 2012). Adjusted rate ratios obtained for the primary exposure were compared to the first multivariate model which had all quarters of data. All the analyses were conducted using SAS Version 9.3 (SAS Institute Inc., Cary, NC, USA).

Results

Descriptive Frequencies of Study Population

The SOC children included in this analysis were all black, and there were slightly more girls (55%) than boys (45%) (**Table 2**). The mean SOC enrollment age for these children is 3.4 years old, making them mostly Pre-Ks (73%) at enrollment. Most of the children (82%) live within three adjacent zip codes in South Atlanta. More than two-thirds (71%) of the children reported some known medical condition at enrollment. The top three conditions reported are Skin conditions/Eczema (31%), Asthma (22%) and Allergies (21%).Only 20% of the children were born premature, and only 22% of the children did not receive prenatal care starting in the first trimester. The mean rate of ED visits from July 2009 to March 2013 for the children was 0.34 visits per quarter, equivalent to 1.37 times a year. Based on CPT codes, most of these visits, 0.30 out of the 0.34 visits per quarter (or 1.20 out of 1.37 visits per year), were for non-urgent reasons.

Considering family characteristics, most children (71%) belong to families in which the primary parent is single and has a mean age of 29.6 at SOC enrollment. In terms of employment, about a third (36%) of the children come from families where the primary parent is employed full time, another third (36%) come from families where the parent is unemployed or working odd jobs, and the remainder (25%) come from families where the parent is part-time employed. The children come from lower income families, with 80% coming from families where the primary parent earns less than $20,000 (125% of 2013 federal poverty line for family of 2 [42]). Also, 81% of the children come from families where the primary parent has at least a high school diploma or GED.

Descriptive Frequencies of ED Visits

Table 3 summarizes information about ED utilization among SOC children. A vast majority of all the ED visits by SOC children occur at Hugh Spalding (87%), are paid for by some form of public insurance (90%), do not result in inpatient admissions (99%) and do not present with a high severity problem (85%). The most common mode of arrival is by car (82%) with 43% of ED visits occur between the hours of 8am and 4pm. The most common primary ICD9 diagnosis among SOC children presenting at the ED is fever (21%), followed by cough (8%) and rash (6%).

ED visits before and after SOC enrollment are similar in terms of ED site, arrival mode, insurance type, inpatient admissions, and problem severity. The vast majority of ED visits after SOC enrollment involved a non-high severity condition (89%), up slightly from 84% of ED visits before SOC enrollment. Time of ED visit changed slightly before and after SOC enrollment: 46% of ED visits after SOC enrollment occur during the hours of 8am to 4pm, up slightly from 40% of visits before SOC enrollment. Furthermore, the scabies exposure (ICD9 codes 133.0 & V01.89) in December 2012 accounted for 16% of all ED visits occurring after SOC enrollment. There were also some differences between ICD9 diagnoses before/after SOC enrollment; the top three ICD9 diagnoses for visits occurring before SOC enrollment were fever (25%), cough (8%) and rash (5%), compared to scabies (16%), fever (15%), and rash (8%) after SOC enrollment. Finally, fever is the most common primary diagnosis for ED visits conducted by SOC children. Among infants visiting the ED, almost one in three visits (33%) has a primary diagnosis of fever; however, among older children the percentage of ED visits with a primary diagnosis of fever decreases to 20% among toddlers and 17% among Pre-Ks (data not shown).

Comparing ED visits occurring after SOC enrollment to visits occurring before SOC enrollment by age group, the percentage of visits that were uninsured decreased for infants (from 8% to 5%) and for pre-Ks (from 9% to 6%), but increased for toddlers (from 5% to 8%) (**Appendix C**). Visits resulting in hospital admissions accounted for a higher percentage of ED visits before SOC enrollment for infants (4% to 0%) and a lower percentage of ED visits before SOC enrollment for toddlers (1% to 4%). The percentage was similar for pre-Ks at about 1% before and after SOC enrollment. For all age groups, visits in which the patient did not present with a high severity condition accounted for a larger proportion of ED visits after SOC enrollment compared to visits before SOC enrollment.

Bivariate Analyses

In bivariate analysis (**Table 4),** only covariates that had at least one category/level with a significant association with the outcome were considered in multivariate modeling as potential confounders and interaction terms. This included five child-level covariates, specifically: age group of child (infant: $p<0.01$), enrollment age ($p<0.01$), zip code at enrollment (30312: $p=0.06$), birth order (1st born: $p=0.04$), and medical condition reported at enrollment ($p=0.07$). All family-level covariates, except number of children in family, were included in the initial multivariate model. The five included family-level covariates were: marital status of primary parent (living together, not married: $p=0.03$), primary parent employment status (full-time: $p<0.01$), primary parent income (all levels: $p<0.05$), primary parent education (college graduate or grad school, $p=0.03$) and age group of parent at enrollment (all levels: $p<0.10$). Lastly, the primary exposure, enrollment in the SOC, had a significant positive association with the outcome ($p=0.03$) in bivariate analysis.

Multivariate Analyses

Multicollinearity analysis resulted in the removal of the interaction between enrollment status and enrollment age because it was collinear with enrollment status and enrollment age. Of the remaining interactions examined, only the interaction between enrollment status and primary parent income (at enrollment) was significant after backward elimination. **Appendix D** (all quarters) and **Appendix E** (all quarters except 2012 quarter four) show the multivariate model which includes all covariates considered initially as potential confounders. Several covariates did not appear to influence the effect of enrollment status and were dropped from the model during confounding analysis to give a final model consisting of enrollment status, child's age group, child's enrollment age, primary parent income, and the interaction between enrollment status and primary parent income.

The final multivariate model for all quarters of data is shown in **Table 5**. Adjusting for confounders mentioned above, the rate of ED visits post-enrollment was not significantly higher than the rate of ED visits pre- enrollment for children whose primary parent reported under $5,000 in annual income at enrollment (aIRR= 1.12, 95% CI: 0.90 - 1.40), and for children whose primary parent reported $20,000-$29,999 in annual income at enrollment (aIRR = 1.36, 95% CI: 0.85 – 2.16). Similarly, the rate of ED visits post-enrollment was not significantly lower than pre-enrollment ED visit rates for children whose primary parent reported $30,000 and over in annual income at enrollment (aIRR = 0.55, 95% CI: 0.26 – 1.17). However, for the children whose primary parent reported $5,000 to $19,999 in annual income at enrollment, the rate of ED visits post-enrollment was significantly higher compared to the rate of ED visits pre-enrollment (aIRR = 1.48, 95% CI: 1.17 – 1.87).

All confounders were significantly associated with rate of ED visits per quarter. Compared to the ED visit rate among children in Pre-K, infants had a significantly higher

rate of ED visits (aIRR = 1.67, 95% CI: 1.29 – 2.17), but toddlers had higher rate of ED visits that was not significant (aIRR = 1.70, 95% CI: 1.41 – 2.05). A one year increase in enrollment age also significantly increased the rate of ED visits by 0.85 (95% CI: 0.78 – 0.94) visits per quarter. Compared to the rate of ED visits for children whose primary parent earned $30,000 -$75,000 in annual income, the rate of ED visits was significantly higher for children whose parents earned under $5,000 in annual income (aIRR = 2.45, 95% CI: 1.49 - 4.02). Children whose parents earned annual incomes of $5,000 - $19,999 and $20,000 - $29,999 did not have significantly higher rates of ED visits compared to the highest income group.

Estimates from the final multivariate model based on analysis that excluded data from 2012 quarter four (**Table 6**) gave estimates similar to the model based on all quarters of data. Adjusting for confounders, the rate of ED visits post-enrollment was not significantly higher than the rate of ED visits pre-enrollment for all levels of income except for the children whose primary parent earned $5,000 - $19,999 in annual income (aIRR = 1.32, 95% CI: 1.02, 1.71).

Discussion

The profile of ED visits made by the SOC children revealed that a vast majority of the visits are non-urgent visits. Most of these visits do not involve the child presenting with a condition of high severity, and almost all these visits do not result in hospital admission. The most common diagnoses associated with these visits are fever, cough and rash, conditions which can be treated in a doctor's office. Also, most of these visits are insured and almost half occurred during the day when doctor's offices are also open. As such, examining total ED visits appeared to be a good proxy for understanding whether SOC enrollment had an impact on non-urgent ED use.

The effect of SOC enrollment on the rate of ED visits differed by income level of the primary parent, but not by the child's medical conditions. Enrollment in the SOC was associated with a significantly higher rate of ED visits among children whose primary parent earned under $5,000 in annual income. For all other levels of primary parent income, enrollment was not associated with ED visits. Enrollment does not appear to decrease the rate of ED visits among children aged 6 months to 5.5 years (pre-K) in the Healthy Beginnings SOC. Due to multicollinearity, the study was unable to assess whether the effect of enrollment differed by child's enrollment age.

The study finding that enrollment in the SOC has no impact on ED utilization for half of the children from households where the primary parent earned over $5,000 in annual income is consistent with other research evaluating the potential effect of educational interventions on ED utilization [32, 35, 36]. However, there are several case management intervention studies [37-40] which find significant decreases in ED utilization. There are two potential reasons why the SOC results differed from these case management interventions. First, the SOC is different from other case management interventions in its target population

and/or in its approach to not requiring PCP referrals before visiting the ED. Second, the analytic horizon for this study is longer, lasting up to two years for some children, compared to other studies evaluating these case management interventions.

The study finding that SOC enrollment is associated with an increased rate of ED utilization among children whose primary parent earned under $5,000 in annual income is unexpected and does not agree with previous literature on interventions to reduce non-urgent ED utilization. However, the finding does agree with the results of a randomized controlled study to understand the effects of Medicaid coverage in Portland [43]. Taubman et al found that Medicaid coverage significantly increased overall ED visits during the 18-month study period, and this increase included ED visits that could have been treated in primary care settings [43]. Given that the HN works with SOC families to ensure that they receive continuous insurance coverage, and that families earning under $5,000 in annual income would likely qualify for Medicaid, the increased ED use among SOC families could be due to increased Medicaid coverage.

Strengths and limitations

The study has at least four strengths. First, the study uses child-level medical records abstracted by CHOA to construct the ED utilization outcome variable, and does not rely on parent self-report that could introduce recall bias. Second, the study utilized longitudinal data, tracking some study participants for up to 2 years after they enrolled in the SOC. This allowed the study to understand the potential long term impacts of case management interventions, as the existing literature on such interventions follows participants for 1 year at most [37-40]. Third, the study obtained data on 85.6% of the children who have ever been enrolled in the SOC as of May 2013, allowing us to understand ED utilization among a vast majority of the children in the SOC. Finally, since the SOC is an ongoing intervention, the

study also provided timely feedback for the SOC to modify its processes, policies and practices, allowing it to better serve the community in the NPU-V neighborhood.

Despite the strengths of this study, there are at least four limitations. First, since the study excluded a small number of children (26 out of 305) who listed other ED sites as their primary ED, the study is not generalizable to all children who enroll in the SOC. Since over 90% of the SOC children listed a CHOA ED as their primary ED, the study findings are still applicable to a vast majority of the SOC children, and are still relevant for informing SOC practices.

Second, the study lacked a comparison population which would have helped to control for temporal trends in healthcare utilization among children in Atlanta. Efforts were made to recruit a comparison population at another early childhood center which serves children with similar demographics as the SOC children, and which is, like Educare Atlanta, located close to CHOA-Hughes Spalding. However, the logistics involved in getting parents of this comparison group to sign health information waivers in order for CHOA to release medical records made obtaining a comparison population infeasible for this study. Although the study coincided with the introduction of the Affordable Care Act (ACA) in 2010 [44], Georgia did not implement changes to Medicaid and PeachCare until 1 January 2014 [45], after the end of data collection. For this reason, the assumption that there were no temporal trends in ED use for this population seems reasonable.

Third, the primary exposure variable could have been misclassified for the quarter in which the child was enrolled. For these quarters, a child was considered enrolled for that quarter if he/she enrolled before the middle of the quarter, and all ED visits in that quarter would be considered as visits occurring after enrollment, even if the visit actually occurred

before enrollment. This exposure misclassification bias was reduced by aggregating data using smaller time intervals of quarters as opposed to years or half-years.

Fourth, some of the child- and family- level covariates were not measured accurately, contributing to potential bias. Child-level covariates such as like birth order and number of children in the family were calculated based on siblings enrolled in the program and did not factor in siblings not enrolled. Several of the family-level demographic covariates (e.g. employment, marital status, income) were measured at SOC enrollment and assumed to be constant throughout the study duration which could also cause bias. Future work can be done to track these child- and family- level covariates on a yearly basis and to improve model effect estimates.

Future Directions

Despite these limitations, this study still provides preliminary findings informing SOC practices and processes. The analysis profiling the characteristics of ED visits can inform the content of future SOC education efforts aimed at reducing ED utilization among enrolled families. For example, the HN can conduct sessions that educate SOC parents on how to care for their child during episodes of fever, cough or rash, including specifics about when to visit the ED. Since a majority of the ED visits are occurring during doctor's office hours, qualitative studies can be conducted to understand the barriers to using primary care doctors. The results of these studies will allow the SOC to work with PCPs to eliminate barriers and encourage PCP use for non-urgent conditions. Understanding PCP barriers would also allow the SOC to recommend suitable alternative treatment locations, such as urgent care centers, where appropriate.

The study also provides a foundation for future research to understand the impact of SOC efforts to reduce non-urgent ED utilization. Future research can improve on this study

by including a comparison group from sites that the SOC will be expanding to. Additionally, future research can also consider whether children have to be enrolled at the SOC for a certain period of time before reductions in ED utilization can be realized. Finally, future studies can measure the impact of SOC enrollment on other outcomes over which it has more influence, such as PCP utilization.

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Table 1. Summary of outcome, exposure, and child- & family- level covariates considered for bivariate and multivariate analysis, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013

Variable	Source	Description	Coding	Time varying?
Outcome				
ED visits per quarter	CHOA ED data	Count of ED visits occurring in that quarter	Counts	Yes
Exposure				
Enrollment into the SOC	SOC database	Enrollment status in middle of quarter (i.e. Enrolled for at least ½ of quarter)	Enrolled/ Not enrolled	Yes
Covariates: Child-level characteristics				
Child's Age Group	SOC database	Age of child as of the middle of quarter	Infant / Toddler /Pre-K	Yes
Enrollment age	SOC database	Age of child at enrollment	Years	No
Gender	SOC database	Child's Gender	M/F	No
Zip code	SOC database	Was child's address in zip 30312, 30310 or 30315 (at enrollment)?	Y/N	No
Child's birth order	SOC database	Birth Order (based only on enrolled children)	1st/ 2nd/ 3rd or higher	No
No Medical Conditions	SOC database	Did the child have any significant medical condition at enrollment?	Y/N	No
Asthma	SOC database	Did the child report having asthma or respiratory problems at enrollment?	Y/N	No
Skin Conditions	SOC database	Did the child report having persistent skin conditions at enrollment?	Y/N	No
Allergies	SOC database	Did the child report having persistent allergies at enrollment?	Y/N	No
Premature birth	SOC database	Was the child born before full term?	Y/N	No
Prenatal care	SOC database	Did the child start prenatal screening in the first trimester?	Y/N	No
Covariates: family-level characteristics				
Family Size	SOC database	Number of children from the same family enrolled in the program	1 / 2 / 3 or more	Yes
Parent Age	SOC database	Primary parent's age group at enrollment	16-20 / 20.1-25 / 25.1-30 / 30.1-35 / Over 35	No
Parent Marital Status	SOC database	Primary parent's marital status at child's enrollment	Single / Living together, not married / Married / Divorced	No

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Table 1 (continued). Summary of outcome, exposure, and child- & family- level covariates considered for bivariate and multivariate analysis, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013

Variable	Source	Description	Coding	Time varying?
Parent Employment Status	SOC database	Primary parent's employment Status at child's enrollment	Full-Time / Part-Time / Unemployed	No
Parent Income Level	SOC database	Primary parent's income level at child's enrollment	Under $5K / $5K - $20K / $20K-$30K/ $30K and Above	No
Parent Educational attainment	SOC database	Primary parent's education level at child's enrollment	Some High School / High School Diploma or GED/ Some college / College or graduate degree	No

Table 2. Child- and family- level characteristics of children enrolled as of May 2013 for whom an ED record could be found, Healthy Beginnings SOC Evaluation study, Atlanta GA (n=262 children).

Characteristics	n (%) or mean (SD)	
Child-Level Characteristics		
Gender		
Female	143	(54.6%)
Male	119	(45.4%)
Race		
Black	262	(100.0%)
non-Black	0	(0.0%)
Age Group of Child at Enrollment		
Infant (6-15 Mos)	29	(11.1%)
Toddler (15 -36 Mos)	40	(15.3%)
Pre-K (36- 66 Mos)	192	(73.3%)
Birth Order (among SOC enrolled children)[1]		
1st	205	(78.2%)
2nd	45	(17.2%)
3rd or higher	12	(4.6%)
Zipcode (at enrollment)		
30310	52	(19.8%)
30312	116	(44.3%)
30315	46	(17.6%)
other zip	48	(18.3%)
Child Protective Service Status		
No CPS or DFCS involvement	251	(95.8%)
CPS Investigation	1	(0.4%)
Close CPS Case - Substantiated	4	(1.5%)
Close CPS Case – Unsubstantiated	0	(0.0%)
Unknown	6	(2.3%)
Medical Conditions at enrollment[2]		
No Known Medical Conditions	77	(29.4%)
Skin Conditions/ Eczema	80	(30.5%)
Asthma/ Respiratory	77	(29.4%)
Allergies	54	(20.6%)
Vision	12	(4.6%)
Anemia	12	(4.6%)
GI Disorders	11	(4.2%)
Hearing Disorders	9	(3.4%)
Overweight or Underweight	7	(2.7%)
Cardiac	7	(2.7%)
Seizures	6	(2.3%)
Behavioral Health	4	(1.5%)
Orthopedic	2	(0.8%)
Neuromuscular	1	(0.4%)
Diabetes	0	(0.0%)
High Blood Pressure	0	(0.0%)
HIV/Infectious Disease	0	(0.0%)
High Lead Levels	0	(0.0%)
Other significant medical conditions	23	(8.8%)

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Table 2 (continued). Child- and family- level characteristics of children enrolled as of May 2013 for whom an ED record could be found, Healthy Beginnings SOC Evaluation study, Atlanta GA (n=262 children).

Characteristics	n (%) or mean (SD)	
Count of medical conditions at enrollment		
None	87	(33.2%)
1	83	(31.7%)
2	64	(24.4%)
3 or more	28	(10.7%)
Premature Birth		
Yes (before 37 weeks)	52	(19.8%)
No (37 or more weeks gestation)	210	(80.2%)
Start of Prenatal Screening[3]		
1st Trimester	195	(78.0%)
2nd Trimester	47	(18.8%)
3rd Trimester	3	(1.2%)
No prenatal care	5	(2.0%)
Number of ED visits per quarter		
None	40	(15.3%)
0.01-0.25	93	(35.5%)
0.26-0.5	76	(29.0%)
0.51-0.75	30	(11.5%)
More than 0.75 visits per quarter	23	(8.8%)
Number of Non-urgent ED visits per quarter (Based on CPT)		
None	52	(19.8%)
0.01-0.25	96	(36.6%)
0.26-0.5	71	(27.1%)
0.51-0.75	24	(9.2%)
More than 0.75 visits per quarter	19	(7.3%)
Mean # of ED visits per quarter from July 2009-March 2013	0.34	(0.41)
Mean # of non-urgent ED visits per quarter from Jul 09-Mar 13	0.30	(0.39)
Mean # of medical conditions at enrollment	1.17	(1.11)
Age of child at enrollment	3.42	(1.35)
Family-Level Characteristics at Enrollment [4]		
Age of Parent (at enrollment)[3]	29.58	(6.77)
Age Group of Parent (at enrollment)[3]		
16-20	6	(2.3%)
20.1 -25	64	(24.8%)
25.1-30	87	(33.7%)
30.1-35	58	(22.5%)
Over 35	43	(16.7%)
Marital Status of Primary Parent (at enrollment)[3]		
Single, Never Married	182	(70.8%)
Living together, not married	30	(11.7%)
Married	19	(7.4%)
Divorce/Separated	26	(10.1%)

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Table 2 (continued). Child- and family- level characteristics of children enrolled as of May 2013 for whom an ED record could be found, Healthy Beginnings SOC Evaluation study, Atlanta GA (n=262 children).

Characteristics	n (%) or mean (SD)	
Annual Primary Parent Income (at enrollment)[3]		
under $ 5,000	101	(39.6%)
$5,000 - $19,999	102	(40.0%)
$20,000 - $29,999	28	(7.5%)
$30,000 - $75,000	24	(9.4%)
Primary Parent Education (at enrollment)[3]		
College Graduate or Graduate School	22	(8.7%)
Some College (includes Associates' Degree)	118	(46.6%)
High School Diploma or GED	64	(25.3%)
Some High School	49	(19.4%)
Primary Parent Employment Status (at enrollment)[3]		
Full-Time (35+hrs)	91	(35.8%)
Part-Time (<35 hrs) or employed student	72	(28.3%)
Unemployed, Odd Jobs, disabled	91	(35.8%)

1 Birth order is only based on children enrolled in the SOC. A child was coded 1st born if they were the oldest among all children enrolled in the SOC, but they might not necessarily be the oldest child in the family in situations where older children were not enrolled in the program

2 Percentages sum to more than 100% since children can have more than medical condition at enrollment

3 Variables with missing observations: Start of Prenatal Screening had 12 missing children; Parent Marital status had 5 missing children; Parent income had 7 missing children; Parent Education had 9 missing children; Parent Employment Status had 8 missing children; Parent age/age group had 4 missing children.

4 Family level characteristics reported when the child enrolled in the SOC. If two children from the same family enrolled at the same time, their family level characteristics would be the same and double counted here. The 262 children come from 204 families.

Table 3. Characteristics of the ED visits of study participants from July 2009 - March 2013, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=1014 visits)

Characteristics[1]	All Visits	Visits before SOC enrollment[2]	Visits after SOC enrollment[2]	P value[3]
Number of visits (n)	1014	616	398	
Mean age at ED visit (in years)	2.70	2.29	3.53	<0.001
Total Cost of visit ($)	$921	$794	$917	0.157
ED location				0.008
Egleston	6%	5%	7%	
Hugh Spalding	87%	86%	89%	
Scottish Rite	7%	9%	4%	
Arrival Mode				0.181
Ambulance	4%	5%	4%	
Car	82%	81%	85%	
Walk-In	13%	15%	11%	
Other	0%	0%	0%	
Insurance Type[4]				0.604
Not insured	7%	7%	7%	
Public Insurance (Medicaid, Peachcare)	90%	89%	90%	
Private Insurance	4%	4%	3%	
Time of arrival				0.054
12am – 7:59am	12%	13%	11%	
8am – 11:59am	23%	22%	23%	
12pm – 3:59pm	20%	18%	23%	
4pm – 7:59pm	26%	26%	27%	
8pm – 11:59pm	19%	21%	15%	
Admitted?				0.781
No	99%	99%	98%	
Yes	1%	1%	2%	
Patient presented problem with high severity (CPT code = 99285 or 99284)				0.0330
No	85%	84%	89%	
Yes	15%	16%	11%	
Age at Visit				<0.001
Infant (6-15 Mos)	18%	23%	11%	
Toddler (15-36 Mos)	38%	50%	19%	
Pre-K (36-66 Mos)	44%	28%	70%	

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Table 3 (continued). Characteristics of the ED visits of study participants from July 2009 - March 2013, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=1014 visits)

Characteristics[1]		All Visits	Visits before SOC enrollment[2]	Visits after SOC enrollment[2]	P value[3]
Primary Diagnoses[5]					<0.001
Fever	[780.60]	21%	25%	15%	
Cough	[786.2]	8%	8%	8%	
Rash	[782.1]	6%	5%	9%	
Scabies or exposure to other communicable disease	[133.0 & V01.89]	6%	0%	16%	
Otalgia	[388.70]	4%	4%	5%	
Vomitting Alone	[787.03]	3%	4%	2%	
Wheezing	[786.07]	3%	3%	2%	
Acute Upper Respiratory Infection	[465.9]	3%	3%	2%	
Diarrhea	[787.91]	2%	3%	1%	
Acute Suppurative Otitis Media	[382.00]	2%	2%	2%	
Head Injury (unspecified)	[959.01]	2%	2%	2%	
Other Respiratory Abnormalities	[786.09]	2%	2%	1%	
Other Diagnoses		41%	38%	43%	

1. % of visits with each characteristic shown, unless otherwise stated
2. Ages of the children are different pre and post enrollment, and differences in profile of visits pre and post enrollment could be due to children growing older
3. P-values were calculated using statistical tests (chi-squared tests of independence and two-sample t-tests with pooled variances) that assume independence visits before and after SOC enrollment. Since many of the same children contribute visits before and after enrollment, the assumption of independence likely does not hold.
4. Insurance Type had 4 missing observations
   Primary ICD 9 codes are shown in brackets after text description. Secondary ICD 9 codes not included

Table 4. Bivariate associations of ED visits from July 2009 - March 2013 with exposure and child- and family-level covariates, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=262 children, 3270 quarters)

Variable	Beta Estimate	Crude Rate Ratio (IRR)	95% CI	P-value
Primary Exposure				
Enrolled in SOC[1]	0.14	1.15	(1.02, 1.31)	0.028
Child-Level Covariates				
Age Group of Child				
Infant (6-15 Mos)	0.58	1.78	(1.48, 2.15)	<.0001
Toddler (15 -36 Mos)	0.06	1.07	(0.93, 1.22)	0.358
Pre-K (36- 66 Mos)	Ref			
Enrollment Age	-0.27	0.76	(0.71, 0.82)	<0.001
Gender				
Female	0.05	1.05	(0.84, 1.32)	0.643
Male	Ref			
Zipcode (at enrollment)				
30310	0.08	1.09	(0.73, 1.61)	0.673
30312	0.33	1.40	(0.99, 1.97)	0.056
30315	0.02	1.02	(0.67, 1.54)	0.937
Other	Ref			
Birth Order (among SOC enrolled children)[2]				
1st	-0.53	0.59	(0.36, 0.96)	0.035
2nd	-0.16	0.85	(0.51, 1.41)	0.531
3rd or higher	Ref			
Has some significant medical condition (at enrollment)				
Yes	0.23	1.26	(0.99, 1.61)	0.066
No significant medical condition	Ref			
Has Asthma/Respiratory Condition (at enrollment)				
Yes	0.17	1.18	(0.93, 1.51)	0.171
No asthma/respiratory condition	Ref			
Has Skin Condition (at enrollment)				
Yes	-0.03	0.97	(0.75, 1.25)	0.818
No skin condition	Ref			
Has Allergies (at enrollment)				
Yes	0.03	1.03	(0.78, 1.36)	0.825
No allergies	Ref			
Born Premature				
Yes	0.22	1.25	(0.94, 1.67)	0.126
Not born premature	Ref			
Start of Prenatal Screening[3]				
1st Trimester	-0.01	0.99	(0.74, 1.33)	0.969
After 1st Trimester	Ref			

(continued on next page)

Table 4 (continued). Bivariate associations of ED visits from July 2009 - March 2013 with exposure and child- and family-level covariates, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=262 children, 3270 quarters)

Variable	Beta Estimate	Crude Rate Ratio (IRR)	95% CI	P-value
Family-Level Covariates				
Number of Children in Family (among SOC enrolled children)				
1	-0.15	0.86	(0.54, 1.37)	0.526
2	0.00	1.00	(0.63, 1.60)	0.984
3 or More	Ref			
Marital Status of Primary Parent (at enrollment)[3]				
Divorced or Separated	-0.29	0.75	(0.48, 1.16)	0.189
Living together, not married	0.41	1.51	(1.04, 2.18)	0.029
Married, first time	-0.27	0.77	(0.47, 1.24)	0.277
Single, never married	Ref			
Primary Parent Employment Status (at enrollment)[3]				
Full-Time (35+hrs)	-0.44	0.64	(0.48, 0.85)	0.002
Part-Time (<35 hrs)/employed student	-0.17	0.85	(0.63, 1.14)	0.279
Unemployed, Odd Jobs, disabled	Ref			
Annual Primary Parent Income (at enrollment)[2]				
under $ 5,000	1.12	3.07	(0.43, 0.97)	<.0001
$5,000 - $19,999	0.77	2.15	(0.20, 0.53)	0.002
$20,000 - $29,999	0.71	2.03	(0.55, 0.94)	0.015
$30,000 - $75,000	Ref			
Primary Parent Education (at enrollment)[3]				
College Graduate or Grad School	-0.62	0.54	(0.31, 0.93)	0.025
Some College (includes Associate's)	-0.31	0.73	(0.52, 1.02)	0.067
High School Diploma or GED	-0.29	0.75	(0.52, 1.09)	0.131
Some High School	Ref			
Age Group of Parent at enrollment[3]				
16 - 20	1.83	6.26	(2.88, 13.63)	<0.001
20.1 - 25	0.63	1.87	(1.26, 2.79)	0.002
25.1 - 30	0.59	1.80	(1.23, 2.63)	0.003
30.1 - 35	0.37	1.45	(0.96, 2.18)	0.075
Over 35	Ref			

1 Effect of enrollment in SOC estimated by comparing post-enrollment quarters to pre-enrollment quarters as the reference

2 Birth order is only based on children enrolled in the SOC. A child was coded 1st born if they were the oldest among all children enrolled in the SOC, but they might not necessarily be the oldest child in the family in situations where older children were not enrolled in the program

3 Variables with missing observations: Start of Prenatal Screening had 12 missing children (143 quarters); Parent Marital status had 5 missing children (46 quarters); Parent income had 7 missing children (74 quarters); Parent Education had 9 missing children (108 quarters); Parent Employment Status had 8 missing children (82 quarters); Parent age/age group had 4 missing children (44 quarters).

Table 5. Multivariate (adjusted) associations of ED visits from July 2009 - March 2013 with exposure and child- and family-level covariates, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=251 children, 3151 quarters)[1]

Variable	Beta Estimate	Adj. Rate Ratio (aIRR)	95% CI	P-value
Primary Exposure:				
Effect of Enrollment[2] (Interacted with Primary Parent Income at enrollment)				
Under $5000 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	0.12	1.12	(0.90, 1.40)	0.298
$5,000-19,999 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	0.39	1.48	(1.17, 1.87)	0.001
$20,000-29,999 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	0.31	1.36	(0.85, 2.16)	0.199
$30,000-75,000 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	-0.61	0.55	(0.26, 1.17)	0.117
Child-Level Covariates				
Age Group of Child				
Infant (6-15 Mos)	0.51	1.67	(1.29, 2.17)	<0.001
Toddler (15 -36 Mos)	0.11	1.12	(0.94, 1.34)	0.217
Pre-K (36- 66 Mos)	Ref			
Enrollment Age	-0.16	0.85	(0.78, 0.94)	0.001
Family-Level Covariates				
Annual Primary Parent Income (at enrollment)				
under $ 5,000	0.89	2.48	(1.49, 4.02)	<0.001
$5,000 - $19,999	0.46	1.58	(0.96, 2.61)	0.074
$20,000 - $29,999	0.47	1.59	(0.88, 2.90)	0.127
$30,000 - $75,000	Ref			

1 Not all the children were included in the multivariate regression due to missing observations for primary parent employment status or primary parent income.

2 Effect of enrollment estimated by comparing post-enrollment quarters to pre-enrollment quarters as the reference

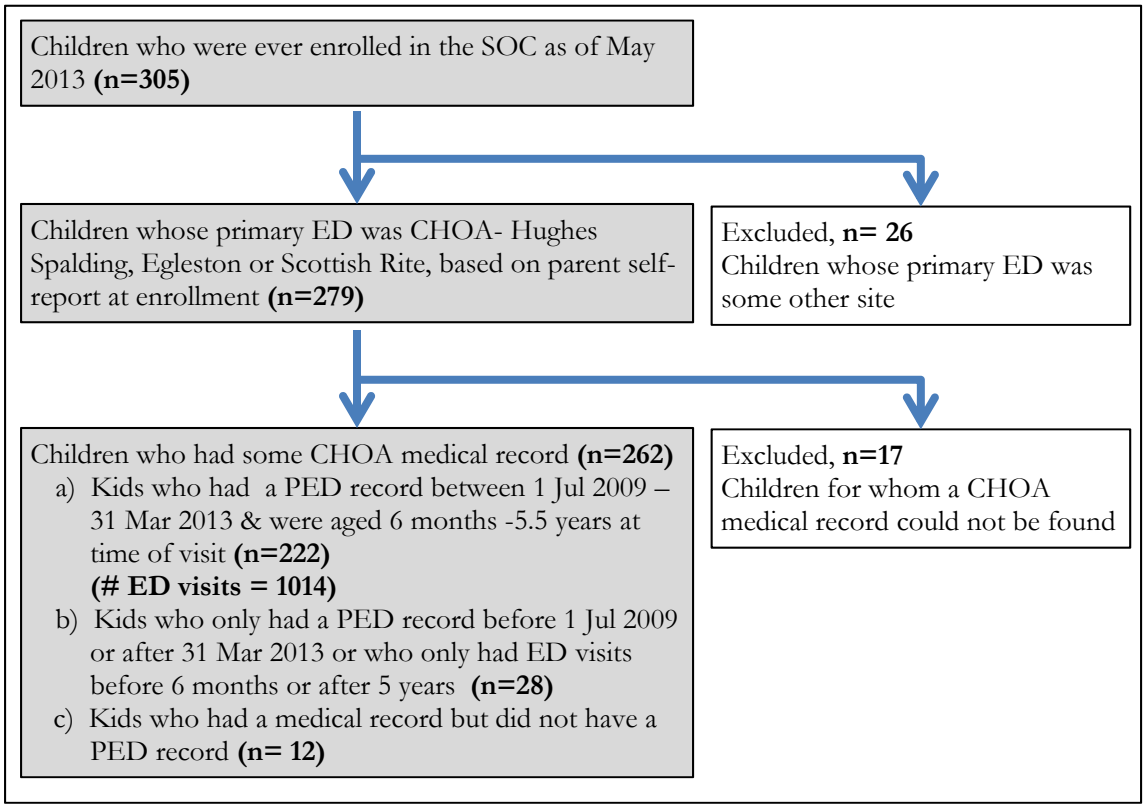
Table 6. Multivariate (adjusted) associations of ED visits from July 2009 - March 2013, excluding October –December 2012, with exposure and child- and family-level covariates, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=251 children, 2964 quarters)[1]

Variable	Beta Estimate	Adj. Rate Ratio (aIRR)	95% CI	P-value
Primary Exposure:				
Effect of Enrollment[2] (Interacted with Primary Parent Income at enrollment)				
Under $5000 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	-0.08	0.93	(0.73, 1.18)	0.541
$5,000-19,999 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	0.28	1.32	(1.02, 1.71)	0.033
$20,000-29,999 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	0.21	1.24	(0.74, 2.07)	0.413
$30,000-75,000 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	-0.66	0.52	(0.22, 1.23)	0.135
Child-Level Covariates				
Age Group of Child				
Infant (6-15 Mos)	0.63	1.87	(1.43, 2.44)	<0.001
Toddler (15 -36 Mos)	0.17	1.18	(0.98, 1.42)	0.075
Pre-K (36- 66 Mos)	Ref			
Enrollment Age	-0.11	0.90	(0.81, 1.00)	0.047
Family-Level Covariates				
Annual Primary Parent Income (at enrollment)				
under $ 5,000	0.95	2.59	(1.55, 4.33)	<0.001
$5,000 - $19,999	0.50	1.65	(0.98, 2.78)	0.061
$20,000 - $29,999	0.52	1.68	(0.90, 3.11)	0.102
$30,000 - $75,000	Ref			

1 Not all the children were included in the multivariate regression due to missing observations for primary parent employment status or primary parent income.

2 Effect of enrollment estimated by comparing post-enrollment quarters to pre-enrollment quarters as the reference

Figure 1. Participant selection flow chart, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013



Appendix A. Child- and family-level characteristics comparing included and excluded children, Healthy Beginnings SOC Evaluation study, Atlanta GA.

Characteristics	Children in Study (n=262) n (%) or mean (SD)		Excluded Children (n=17) n (%) or mean (SD)		P-value
Child-Level Characteristics					
Gender					0.805
Female	143	(55%)	10	(59%)	
Male	119	(45%)	7	(41%)	
Race					-
Black	262	(100%)	17	(100%)	
non-Black	0	(0%)	0	(0%)	
Age Group of Child at Enrollment					0.698
Infant (6-15 Mos)	29	(11%)	1	(6%)	
Toddler (15 -36 Mos)	40	(15%)	4	(24%)	
Pre-K (36- 66 Mos)	192	(73%)	12	(71%)	
Birth Order (among SOC enrolled children)[1]					0.691
1st	205	(78%)	14	(82%)	
2nd	45	(17%)	2	(12%)	
3rd or more	12	(5%)	1	(6%)	
Zipcode (at enrollment)					0.004
30310	52	(20%)	0	(0%)	
30312	116	(44%)	5	(29%)	
30315	46	(18%)	3	(18%)	
other zip	48	(18%)	9	(53%)	
Child Protective Service Status					0.176
No CPS or DFCS involvement	251	(96%)	16	(94%)	
CPS Investigation	1	(0%)	0	(0%)	
Close CPS Case - Substantiated	4	(2%)	0	(0%)	
Close CPS Case – Unsubstantiated	0	(0%)	1	(6%)	
Unknown	6	(2%)	0	(0%)	
Medical Conditions at enrollment[2,3]					
No Known Medical Conditions	87	(33%)	9	(53%)	0.116
Skin Conditions/ Eczema	80	(31%)	6	(35%)	0.787
Asthma/ Respiratory	77	(29%)	2	(12%)	0.166
Allergies	54	(21%)	3	(18%)	1.000
Vision	12	(5%)	0	(0%)	1.000
Anemia	12	(5%)	0	(0%)	1.000
GI Disorders	11	(4%)	0	(0%)	1.000
Hearing Disorders	9	(3%)	0	(0%)	1.000
Overweight or Underweight	7	(3%)	0	(0%)	1.000
Cardiac	7	(3%)	0	(0%)	1.000
Seizures	6	(2%)	0	(0%)	1.000
Behavioral Health	4	(2%)	0	(0%)	1.000
Orthopedic	2	(1%)	0	(0%)	1.000
Neuromuscular	1	(0%)	0	(0%)	1.000
Other significant medical conditions	23	(9%)	0	(0%)	0.376

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Appendix A (continued). Child- and family-level characteristics comparing included and excluded children, Healthy Beginnings SOC Evaluation study, Atlanta GA.

Characteristics	Children in Study (n=262) n (%) or mean (SD)		Excluded Children (n=17) n (%) or mean (SD)		P-value
Count of conditions at enrollment					0.199
None	87	(33%)	9	(53%)	
1	83	(32%)	6	(35%)	
2	64	(24%)	1	(6%)	
3 or more	28	(11%)	1	(6%)	
Premature Birth					0.540
Yes (before 37 weeks)	52	(20%)	2	(12%)	
No (37 or more weeks gestation)	210	(80%)	15	(88%)	
Start of Prenatal Screening[4]					0.515
1st Trimester	195	(78%)	12	(80%)	
2nd Trimester	47	(19%)	2	(13%)	
3rd Trimester	3	(1%)	0	(0%)	
No prenatal care	5	(2%)	1	(7%)	
Count of conditions at enrollment	1.17	(1.11)	0.65	(0.86)	0.058
Age of child at enrollment	3.42	(1.35)	3.55	(1.43)	0.689
Family-Level Characteristics at Enrollment [5]					
Age of Parent at enrollment	29.58	(6.77)	32.33	(8.77)	0.109
Age Group of Parent at enrollment[4]					0.359
16-20	6	(2%)	0	(0%)	
20.1 -25	64	(25%)	2	(12%)	
25.1-30	87	(34%)	8	(47%)	
30.1-35	58	(22%)	2	(12%)	
35 and up	43	(17%)	5	(29%)	
Marital Status of Primary Parent[4]					0.015
Single, Never Married	182	(71%)	7	(41%)	
Living together, not married	30	(12%)	2	(12%)	
Married	19	(7%)	4	(24%)	
Divorce/Separated	26	(10%)	3	(18%)	
Annual Primary Parent Income[4]					0.022
under $ 5,000	101	(40%)	8	(47%)	
$5,000 - $19,999	102	(40%)	0	(0%)	
$20,000 - $29,999	28	(11%)	0	(0%)	
$30,000 - $75,000	24	(9%)	3	(18%)	
Primary Parent Education[4]					0.943
College Graduate or Graduate School	22	(9%)	2	(12%)	
Some College (includes Associates' Degree)	118	(47%)	8	(47%)	
High School Diploma or GED	64	(25%)	4	(24%)	
Some High School	49	(19%)	3	(18%)	
Primary Parent Employment Status[4]					0.950
Full-Time (35+hrs)	91	(36%)	7	(41%)	
Part-Time (<35 hrs) or employed student	72	(28%)	4	(24%)	
Unemployed, Odd Jobs, disabled	91	(36%)	6	(35%)	

1 Birth order is only based on children enrolled in the SOC. A child was coded 1st born if they were the oldest among all children enrolled in the SOC, but they might not necessarily be the oldest child in the family in situations where older children were not enrolled in the program
2 Percentages sum to more than 100% since children can have more than medical condition at enrollment.
3 Other significant medical conditions asked about at enrollment include diabetes, high blood pressure, HIV/Infectious disease and high lead levels. None of the children included in the study were reported as having these significant medical conditions
4 Variables with missing observations: Start of Prenatal Screening had 12 missing children; Parent Marital status had 5 missing children; Parent income had 7 missing children; Parent Education had 9 missing children; Parent Employment Status had 8 missing children; Parent age/age group had 4 missing children.
5 Family level characteristics reported when the child enrolled in the SOC. If two children from the same family enrolled at the same time, their family level characteristics would be the same and double counted here. The 262 children come from 204 families.

Appendix B. Definition of CPT Codes Used to Determine ED Severity, Healthy Beginnings SOC Evaluation Study, Atlanta GA, 2013

CPT Code	Description[1]
99285	Emergency department visit for the evaluation and management of a patient, which requires these 3 key components within the constraints imposed by the urgency of the patient's clinical condition and/or mental status: A comprehensive history; A comprehensive examination; and Medical decision making of high complexity. Counseling and/or coordination of care with other physicians, other qualified health care professionals, or agencies are provided consistent with the nature of the problem(s) and the patient's and/or family's needs. Usually, the **presenting problem(s) are of high severity and pose an immediate significant threat to life or physiologic function.**
99284	Emergency department visit for the evaluation and management of a patient, which requires these 3 key components: A detailed history; A detailed examination; and Medical decision making of moderate complexity. Counseling and/or coordination of care with other physicians, other qualified health care professionals, or agencies are provided consistent with the nature of the problem(s) and the patient's and/or family's needs. Usually, the presenting **problem(s) are of high severity, and require urgent evaluation by the physician physicians, or other qualified health care professionals but do not pose an immediate significant threat to life or physiologic function.**
99283	Emergency department visit for the evaluation and management of a patient, which requires these 3 key components: An expanded problem focused history; An expanded problem focused examination; and Medical decision making of moderate complexity. Counseling and/or coordination of care with other physicians, other qualified health care professionals, or agencies are provided consistent with the nature of the problem(s) and the patient's and/or family's needs. Usually, the **presenting problem(s) are of moderate severity.**
99282	Emergency department visit for the evaluation and management of a patient, which requires these 3 key components: An expanded problem focused history; An expanded problem focused examination; and Medical decision making of low complexity. Counseling and/or coordination of care with other physicians, other qualified health care professionals, or agencies are provided consistent with the nature of the problem(s) and the patient's and/or family's needs. Usually, the **presenting problem(s) are of low to moderate severity.**
99281	Emergency department visit for the evaluation and management of a patient, which requires these 3 key components: A problem focused history; A problem focused examination; and Straightforward medical decision making. Counseling and/or coordination of care with other physicians, other qualified health care professionals, or agencies are provided consistent with the nature of the problem(s) and the patient's and/or family's needs. Usually, the **presenting problem(s) are self-limited or minor.**

1 Emphasis added

Source: American Medical Association. CPT code/Relative Value Search. Available at: http://ocm.ama-assn.org/OCM/CPTRelativeValueSearch.do Accessed Jan 24, 2014.

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Appendix C. Characteristics of the ED visits of study participants from July 2009 - March 2013, by age and enrollment status, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=1014 visits)

	Infant (6-15 Mos)		Toddler (15 -36 Mos)		Pre-K (36- 66 Mos)	
	Pre-SOC	Post-SOC	Pre-SOC	Post-SOC	Pre-SOC	Post-SOC
Number of visits (n)	141	44	305	76	170	278
Distribution	14%	4%	30%	7%	17%	27%
Mean age at ED visit (in years)	0.88	0.92	2.15	2.16	3.73	4.32
Total Cost of visit ($)	$1,019	$748	$686	$1,161	$800	$877
ED site						
Egleston	5%	9%	6%	8%	3%	6%
Hugh Spalding	87%	91%	85%	91%	87%	89%
Scottish Rite	8%	0%	9%	1%	10%	5%
Arrival Mode						
Ambulance	2%	2%	6%	1%	5%	4%
Car	83%	82%	79%	89%	81%	85%
Walk-In	15%	14%	15%	9%	14%	11%
Other	0%	2%	0%	0%	1%	0%
Insurance Type[1]						
Not insured	8%	5%	5%	8%	9%	6%
Public Insurance (Medicaid, PeachCare)	90%	93%	93%	87%	82%	91%
Private Insurance	2%	2%	2%	5%	9%	3%
Time of arrival						
12am - 759am	12%	11%	12%	18%	15%	9%
8am - 1159am	27%	16%	18%	18%	26%	26%
12pm - 359pm	17%	27%	20%	21%	15%	23%
4pm - 759pm	20%	25%	30%	28%	24%	27%
8pm - 1159pm	24%	20%	20%	14%	21%	14%
Admitted?						
No	96%	100%	99%	96%	99%	99%
Yes	4%	0%	1%	4%	1%	1%
Patient presented problem with high severity (CPT code = 99285 or 99284)						
No	86%	95%	84%	87%	82%	88%
Yes	14%	5%	16%	13%	18%	12%

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Appendix C (continued). Characteristics of the ED visits of study participants from July 2009 - March 2013, by age and enrollment status, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=1014 visits)

	Infant (6-15 Mos)		Toddler (15 -36 Mos)		Pre-K (36- 66 Mos)	
	Pre-SOC	Pre-SOC	Pre-SOC	Pre-SOC	Pre-SOC	Pre-SOC
Primary Diagnoses[2, 3]						
Fever [780.60]	34%	27%	20%	17%	24%	13%
Cough [786.2]	6%	7%	9%	5%	9%	9%
Rash [782.1]	4%	16%	5%	11%	6%	7%
Scabies or exposure to other communicable disease [133.0 & V01.89]	0%	11%	0%	12%	0%	18%
Otalgia [388.70]	4%	5%	3%	3%	5%	5%
Vomitting Alone [787.03]	6%	0%	4%	0%	2%	3%
Wheezing [786.07]	4%	5%	3%	3%	4%	1%
Acute Upper Respiratory Infection [465.9]	4%	0%	4%	1%	2%	2%
Diarrhea [787.91]	4%	0%	4%	1%	1%	0%
Acute Suppurative Otitis Media [382.00]	4%	5%	2%	3%	1%	1%
Head Injury (unspecified) [959.01]	0%	0%	2%	4%	2%	2%
Other Respiratory Abnormalities [786.09]	1%	0%	3%	3%	1%	1%
Other Diagnoses	29%	25%	39%	38%	43%	39%

1 Insurance type had 4 missing observations

2 ICD 9 codes are in brackets after text description

3 Scabies exposure in Dec 2012 resulted in a recommendation for all children to be treated, but several children were unable to receive care at their PCPs due to refusals to treat and had visit the CHOA ED instead. As such, % of ED visits after SOC enrollment with scabies primary diagnosis increased, and % of ED visits with fever primary diagnosis decreased correspondingly.

Appendix D. Multivariate (adjusted) associations of ED visits from July 2009 - March 2013 with exposure and child- and family-level covariates, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=244 children, 3054 quarters)[1]

Variable	Beta Estimate	Adj. Rate Ratio (aIRR)	95% CI	P-value
Primary Exposure				
Effect of Enrollment[2] (Interacted with Primary Parent Income at enrollment)				
Under $5000 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	0.10	1.10	(0.88, 1.38)	0.397
$5,000-19,999 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	0.43	1.54	(1.21, 1.96)	0.001
$20,000-29,999 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	0.37	1.45	(0.89, 2.37)	0.139
$30,000-75,000 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	-0.68	0.50	(0.23, 1.09)	0.083
Child-Level Covariates				
Age Group of Child				
Infant (6-15 Mos)	0.53	1.69	(1.30, 2.21)	<.0001
Toddler (15 -36 Mos)	0.11	1.12	(0.93, 1.34)	0.238
Pre-K (36- 66 Mos)	Ref			
Enrollment Age	-0.16	0.86	(0.76, 0.96)	0.009
Zipcode (at enrollment)				
30310	0.1753	1.19	(0.81, 1.76)	0.3792
30312	0.4084	1.50	(1.07, 2.11)	0.0187
30315	0.21	1.23	(0.83, 1.85)	0.303
Other	Ref			
Birth Order (among SOC enrolled children)[3]				
1st	0.35	1.42	(0.88, 2.32)	0.154
2nd	0.34	1.40	(0.88, 2.23)	0.157
3rd or higher	Ref			
Has some significant medical condition (at enrollment)				
Yes	0.28	1.33	(1.07, 1.65)	0.012
No significant medical condition	Ref			
Family-Level Covariates				
Marital Status of Primary Parent (at enrollment)				
Divorced or Separated	0.06	1.06	(0.69, 1.64)	0.795
Living together, not married	0.29	1.33	(0.94, 1.88)	0.105
Married, first time	-0.05	0.95	(0.58, 1.55)	0.844
Single, never married	Ref			
Primary Parent Employment Status (at enrollment)				
Full-Time (35+hrs)	0.07	1.07	(0.74, 1.56)	0.715
Part-Time (<35 hrs)/employed student	-0.16	0.85	(0.62, 1.17)	0.327
Unemployed, odd jobs, disabled	Ref			
Annual Primary Parent Income (at enrollment)				
under $ 5,000	0.82	2.27	(1.17, 4.38)	0.015
$5,000 - $19,999	0.44	1.55	(0.84, 2.85)	0.163
$20,000 - $29,999	0.35	1.42	(0.73, 2.75)	0.304
$30,000 - $75,000	Ref			

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Appendix D (continued). Multivariate (adjusted) associations of ED visits from July 2009 - March 2013 with exposure and child- and family-level covariates, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=244 children, 3054 quarters)[1]

Variable	Beta Estimate	Adj. Rate Ratio (aIRR)	95% CI	P-value
Primary Parent Education (at enrollment)				
College Graduate or Grad School	-0.21	0.81	(0.44, 1.49)	0.496
Some College (includes Associate's)	-0.19	0.82	(0.59, 1.16)	0.262
High School Diploma or GED	-0.32	0.73	(0.51, 1.03)	0.074
Some High School	Ref			
Age Group of Parent (at enrollment)				
16 – 20	0.96	2.62	(1.18, 5.80)	0.018
20.1 - 25	0.53	1.70	(1.11, 2.61)	0.016
25.1 - 30	0.41	1.50	(0.99, 2.26)	0.053
30.1 - 35	0.49	1.63	(1.08, 2.44)	0.019
Over 35	Ref			

1 Not all the children were included in the multivariate regression due to missing observations for primary parent marital status, primary parent employment status, primary parent income, primary parent education or primary parent age group.

2 Effect of enrollment estimated by comparing post-enrollment quarters to pre-enrollment quarters as the reference

Appendix E. Multivariate (adjusted) associations of ED visits from July 2009 - March 2013, excluding October –December 2012, with exposure and child- and family-level covariates, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=244 children, 2873 quarters)[1]

Variable	Beta Estimate	Adj. Rate Ratio (aIRR)	95% CI	P-value
Primary Exposure				
Effect of Enrollment[2] (Interacted with Primary Parent Income at enrollment)				
Under $5000 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	-0.09	0.91	(0.71, 1.17)	0.468
$5,000-19,999 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	0.32	1.37	(1.06, 1.78)	0.018
$20,000-29,999 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	0.26	1.30	(0.75, 2.25)	0.344
$30,000-75,000 in primary parent income: Post-enrollment vs Pre-enrollment (Ref)	-0.68	0.50	(0.21, 1.20)	0.123
Child-Level Covariates				
Age Group of Child				
Infant (6-15 Mos)	0.64	1.90	(1.44, 2.50)	<0.001
Toddler (15 -36 Mos)	0.16	1.18	(0.97, 1.42)	0.090
Pre-K (36- 66 Mos)	Ref			
Enrollment Age	-0.08	0.92	(0.82, 1.03)	0.130
Has some significant medical condition (at enrollment)				
Yes	0.32	1.38	(1.09, 1.75)	0.008
No significant medical condition	Ref			
Family-Level Covariates				
Marital Status of Primary Parent (at enrollment)				
Divorced or Separated	0.01	1.01	(0.63, 1.60)	0.982
Living together, not married	0.30	1.35	(0.93, 1.96)	0.111
Married, first time	-0.06	0.94	(0.56, 1.57)	0.818
Single, never married	Ref			
Primary Parent Employment Status (at enrollment)				
Full-Time (35+hrs)	0.14	1.15	(0.77, 1.72)	0.493
Part-Time (<35 hrs)/employed student	-0.06	0.94	(0.67, 1.31)	0.709
Unemployed, odd jobs, disabled	Ref			
Annual Primary Parent Income (at enrollment)				
under $ 5,000	0.96	2.62	(1.32, 5.21)	0.006
$5,000 - $19,999	0.51	1.67	(0.88, 3.16)	0.117
$20,000 - $29,999	0.52	1.68	(0.85, 3.31)	0.135
$30,000 - $75,000	Ref			
Primary Parent Education (at enrollment)				
College Graduate or Grad School	-0.19	0.83	(0.43, 1.58)	0.567
Some College (includes Associate's)	-0.25	0.78	(0.54, 1.11)	0.162
High School Diploma or GED	-0.31	0.73	(0.51, 1.06)	0.102
Some High School	Ref			

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Appendix E (continued). Multivariate (adjusted) associations of ED visits from July 2009 - March 2013, excluding October –December 2012, with exposure and child- and family-level covariates, Healthy Beginnings SOC evaluation study, Atlanta GA, 2013 (n=244 children, 2873 quarters)[1]

Variable	Beta Estimate	Adj. Rate Ratio (aIRR)	95% CI	P-value
Age Group of Parent (at enrollment)				
16 – 20	1.09	2.98	(1.30, 6.84)	0.010
20.1 – 25	0.58	1.79	(1.13, 2.83)	0.012
25.1 – 30	0.39	1.47	(0.95, 2.27)	0.083
30.1 – 35	0.44	1.55	(1.00, 2.38)	0.049
Over 35	Ref			

1 Not all the children were included in the multivariate regression due to missing observations for primary parent marital status, primary parent employment status, primary parent income, primary parent education or primary parent age group.

2 Effect of enrollment estimated by comparing post-enrollment quarters to pre-enrollment quarters as the reference

3 Primary parent income recorded at enrollment.