Impact of Early Head Start in North Carolina on Dental Care Use Among Children Younger Than 3 Years

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Objectives. To examine the effects of North Carolina Early Head Start (EHS), an early education program for low-income children younger than 3 years and their families, on dental care use among children.

Methods. We performed a quasi-experimental study in which we interviewed 479 EHS and 699 non-EHS parent–child dyads at baseline (2010–2012) and at a 24-month follow-up (2012–2014). We estimated the effects of EHS participation on the probability of having a dental care visit after controlling for baseline dental care need and use and a propensity score covariate; we included random effects to account for EHS program clustering.

Results. The odds of having a dental care visit of any type (adjusted odds ratio [OR] = 2.5; 95% confidence interval [CI] = 1.74, 3.48) and having a preventive dental visit (adjusted OR = 2.6; 95% CI = 1.84, 3.63) were higher among EHS children than among non-EHS children. In addition, the adjusted mean number of dental care visits among EHS children was 1.3 times (95% CI = 1.17, 1.55) the mean number among non-EHS children.

Conclusions. This study is the first, to our knowledge, to demonstrate that EHS participation increases dental care use among disadvantaged young children. (*Am J Public Health.* 2017;107:614–620. doi:10.2105/AJPH.2016.303621)

See also Galea and Vaughan, p. 500.

The Centers for Disease Control and Prevention recommends dental care services during early childhood "to improve the health of infants, children, and adolescents and promote healthy lifestyles that will enable them to achieve their full potential."[1(p1)] Similarly, the Institute of Medicine states that "improving access to oral health care is a critical and necessary first step to improving oral health outcomes and reducing disparities."[2(p4)] The use of preventive dental care among young children at risk for dental disease is encouraged by state Medicaid programs as part of the early and periodic screening, diagnostic, and treatment benefit.[3] Preventive dental services are effective in protecting against dental caries among children and are associated with reduced dental care expenditures.[4–6]

Despite the risk of dental caries in young children and the documented benefits of early preventive dental care, use of dental services among children, particularly very young children from low-income families, is low.[7] In 2009, only 7.6% of children from birth to 2 years of age had any type of dental care, and only 1.7% had a preventive dental visit.[7] According to the Institute of Medicine, "In 2008, 4.6 million children did not obtain needed dental care because their families could not afford it."[2(p1)] Not surprisingly, the prevalence of untreated dental caries was higher among socioeconomically vulnerable children.[8,9] Recent evidence suggests that use of dental services is increasing beyond historically low levels; however, the way in which this trend is affecting children younger than 3 years is not clear, and significant structural barriers to obtaining recommended dental services remain for children in this age group.[10,11]

Evidence suggests that social programs targeting disadvantaged families improve dental care use.[12–14] Early Head Start (EHS), a nationwide comprehensive early education program established in the 1990s for low-income families and children from birth to 3 years of age, has the potential to promote dental care use. It targets families at the greatest risk for poor oral health,[15] provides comprehensive family services and support, improves social and cognitive development,[16–19] and operates according to comprehensive federal performance standards that incorporate oral health elements (tooth brushing with fluoridated toothpaste, oral health education, and determination of a child's oral health status by a dental professional).[20–22]

Although oral health is an integral part of recommended EHS program activities, little is known about the effects of the program on the oral health outcomes of enrolled children.[19,23] One national study implemented soon after the establishment of the EHS program showed that there were no differences in dental care use between

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children enrolled and not enrolled in EHS.[24] However, this study was conducted when EHS was a new program beginning to develop performance standards that may not have prioritized oral health referral systems.

In the study described here, we sought to determine the effects of EHS participation on parent-reported dental care use among children in North Carolina. We hypothesized that use of preventive, treatment, and overall dental services would be higher among children enrolled in EHS than among non-EHS children.

METHODS

We used data from the Zero Out Early Childhood Caries (ZOE) study, a longitudinal prospective investigation undertaken to estimate the effects of enrollment in EHS on oral health outcomes among young children. An EHS group was compared with a matched control group of children not enrolled in EHS with respect to type of dental care use (preventive, treatment, emergency, and overall) and number of overall visits (see Appendix A, available as a supplement to the online version of this article at http://www.ajph.org). Teachers and staff in participating North Carolina programs received 1 to 2 hours of didactic training in children's oral health to bolster their awareness of EHS performance standards and help facilitate the implementation of these standards. The goal was to promote maximum implementation of the federal EHS oral health performance standards through a minimal but practical intervention.

Sample

The sampling strategy for the ZOE study involved 3 stages: enrollment of EHS programs, enrollment of parent–child dyads within these programs, and enrollment of community-matched parent–child dyads to serve as controls. All North Carolina EHS programs were invited to participate in stage 1, and all but 1 were enrolled. In stage 2, the research team recruited parents of EHS children from all of the participating programs.

The following criteria were used for enrollment of EHS and non-EHS parent–child dyads: the child had to be younger than 19 months and the parent older than 18 years; the interviewee had to be the primary caregiver; the family had to have no plans to move from the county or, in the case of EHS participants, withdraw from the program; and the interviewee had to speak English or Spanish fluently. Also, non-EHS parents were required to have never had a child participating in EHS or the EHS prenatal program and to have never volunteered or worked for EHS.

In stage 3, Medicaid-enrolled children of the same age, language status, and zip code as already-enrolled EHS parent–child dyads were randomly selected from Medicaid files and recruited as the control group via direct mailings from the North Carolina Medicaid program. The sample yielded EHS and non-EHS parent–child dyads clustered within 25 of the state's 26 EHS programs.

Procedures

Trained interviewers administered structured, 1-hour in-person interviews to parents at baseline (when the child was younger than 19 months) and follow-up (approximately 24 months after the baseline interviews, which coincided with children aging out of the EHS program when they were 36 months old). The outcome variable, dental care use, was included in both the baseline and follow-up interviews. English and Spanish questionnaires were administered as appropriate. Baseline interviews were conducted from September 2010 to July 2012, and follow-up interviews were conducted from November 2012 to March 2014.

Measures

Data on the primary independent variable, EHS enrollment, were supplied by EHS staff and confirmed by the parent at the baseline enrollment screening and interview. The dependent variable, overall dental care use among children, was assessed as both a binary and a count variable in separate analyses. The binary variable indicated a positive response by the parent to the following question, asked at follow-up: "Has your child ever been to a dentist or dental clinic?" The count variable recorded the number of lifetime dental care visits among children, as reported by parents at the follow-up interview.

Type of dental visit was determined via the question "What dental treatments has your child received during his or her lifetime?" Preventive dental care use was defined as "routine check-ups" or "fluoride or other preventive treatments" in addition to open-ended responses such as "cleanings." Treatment dental use was defined as "fillings for a cavity or toothache" or "tooth pulled" in addition to open-ended responses such as "caps." Emergency dental care use was based on "emergency visit for an injury" being reported as the reason for either the first dental visit or lifetime dental care use; a visit was also considered an emergency if the parent volunteered responses such as "fell and broke front tooth."

We included 2 baseline covariates in our analyses because of their potential impact on future dental use: dental care need ("During your child's life, has he or she ever needed dental care or check-ups?") and dental care use ("Has your child ever been to a dentist or dental clinic?") from birth to the time of the baseline interview.

Data Analyses

We performed an intent-to-treat analysis in which the treatment indicator (EHS participation with project oral health support provided by ZOE) was as assigned. Before modeling the relationship between EHS participation and dental care use, we examined the unadjusted relationship between EHS enrollment and having 1 or more dental care visits (preventive, treatment, emergency, and overall). In all of our analytical models, we controlled for baseline dental care need and baseline dental care use and directly adjusted for a generalized boosted model propensity score covariate based on 47 sociodemographic factors and the EHS enrollment criteria.[25]

We controlled for clustering of participants within EHS programs ($n = 25$). These clusters corresponded to geographic areas (zip codes) where EHS and non-EHS study participants resided. With the exception of emergency visits, which were infrequent, random effects were used to control for clustering within each of the 25 EHS programs.

Logistic regression models. We used logistic regression to examine the effects of EHS participation on dental care use, with separate models for each type of care use (preventive, treatment, emergency, and overall). We modeled the probability of receipt of dental services at the 24-month follow-up for each child in each EHS program cluster. The models included the following independent variables: EHS enrollment indicator, needed dental care at baseline (dichotomous), dental visits at baseline (dichotomous), and the estimated propensity score. We also included random effects assuming a mean of zero and normally distributed errors. We estimated the EHS cluster-specific odds ratio (OR) as the odds of receipt of dental care services by an EHS child relative to the odds for a non-EHS child, conditional on the EHS and non-EHS child being from the same geographic area.

In addition, we used the method of recycled predictions to estimate the marginal effects of EHS participation. The continuous independent variable, propensity score, passed 2 tests assessing model misspecification: the Pregibon link test and the Hosmer and Lemeshow goodness-of-fit test. We used the delta method to calculate standard errors and 95% confidence intervals (CIs) for marginal percentage point differences. Stata version 14 (StataCorp LP, College Station, TX) was used in conducting data analyses for the logit models.

Count model. We used a marginalized zero-inflated negative binomial model with random effects to estimate the marginal mean increment in number of overall dental care visits among EHS children relative to non-EHS children; this method accounted for overdispersed distributions of counts with a significant number of zeros.[26] The benefit of using a marginalized model as opposed to a traditional zero-inflated model is that it parameterizes covariate effects directly on the overall mean, providing interpretable covariate effects on that mean.[26–28] By contrast, the traditional zero-inflated model would have modeled the mean count for the "susceptible class" of children said to be at risk for having dental care visits rather than for all children in the population.

Our model (described in Appendix B, available as a supplement to the online version of this article at http://www.ajph.org) extended the marginalized zero-inflated negative binomial for independent counts[26] to allow for clustering while also extending the marginalized zero-inflated Poisson model with random effects[29] to allow for overdispersion (counts with extra-Poisson variation). As described in Appendix C (available as a supplement to the online version of this article at http://www.ajph.org), we used SAS/STAT version 9.4 (SAS Institute, Cary, NC) to conduct the data analyses for the count model.

RESULTS

We enrolled 60% (n = 634) of an estimated 1054 eligible participants enrolled in North Carolina EHS programs and 9% (n = 927) of the 9967 randomly selected children enrolled in Medicaid. Follow-up interviews were completed with 479 parent–child dyads from EHS programs and 699 non-EHS controls, resulting in a 75% follow-up rate for both groups.

Baseline characteristics of the EHS and non-EHS children were similar with respect to gender, age, public insurance enrollment, and physical, learning, or mental health limitations; however, more EHS children than non-EHS children had been homeless and were members of minority racial/ethnic groups (Table 1). EHS and non-EHS parents' baseline characteristics were similar in terms of gender, age, language, nativity, receipt of government benefits (Special Supplemental Nutrition Program for Women, Infants, and Children), and full- or part-time employment status. However, compared with parents whose children were not enrolled in EHS, more parents of EHS children were single or had never been married, received food stamps, received child-care subsidies, received housing assistance, were enrolled in Medicaid, and were in school or training programs; they also were less educated (Table 1).

Of the 699 non-EHS control children in the ZOE study, 240 (34%) were reported at follow-up to have participated in a child-care, preschool, or day-care program that was not part of EHS (Appendix D, available as a supplement to the online version of this article at http://www.ajph.org). Although few non-EHS parents were enrolled in the EHS prenatal program (2%; n = 15), 23% (n = 119) had participated in Head Start themselves as children (Appendix D). At follow-up, 67% (n = 321) of EHS children were still enrolled in the program, and 7% (n = 50) of non-EHS children were enrolled (Appendix E, available as a supplement to the online version of this article at http://www.ajph.org).

At the follow-up interview, significantly more EHS than non-EHS children were reported to have had an overall dental care visit (81% vs 59%; unadjusted OR = 3.5; 95% CI = 2.6, 4.6; Table 2). After control for baseline dental care need, having had a dental visit at baseline, and the propensity score covariate, odds of having a dental visit were higher among EHS children than among non-EHS children within the same cluster (adjusted OR = 2.46; 95% CI = 1.7, 3.5; Table 3). EHS enrollment was associated with a 17.2% (95% CI = 10.7%, 23.6%) increase in the probability of having at least 1 dental care visit relative to nonenrollment.

Similar to the findings for overall dental care use, significantly more EHS than non-EHS children had a preventive dental visit according to both the unadjusted (Table 2; 79% vs 56%; unadjusted OR = 3.4; 95% CI = 2.6, 4.6) and adjusted (Table 3) effect estimates (adjusted OR = 2.59; 95% CI = 1.8, 3.6). EHS enrollment was associated with a 19.0% (95% CI = 12.4%, 25.6%) increase in the probability of having at least 1 preventive dental visit during the follow-up period relative to nonenrollment.

The percentage of children with treatment or emergency dental care visits was less than 10% in both the EHS and non-EHS groups (Table 2). No differences were found between EHS and non-EHS children in adjusted estimates for treatment or emergency dental visits (OR = 0.67; 95% CI = 0.40, 1.11, and OR = 0.79; 95% CI = 0.29, 2.20, respectively; Table 3).

By the time of the follow-up interview, EHS children had, on average, 1.53 times more dental care visits than non-EHS children (2.6 vs 1.7; $P < .01$; Appendix F,

TABLE 1—Baseline Child and Parent Characteristics, by Group: Zero Out Early Childhood Caries Study, North Carolina

Characteristic	EHS Group (n = 479)	Non-EHS Group (n = 699)	P
Child characteristics			
Age, mo, mean (SD; range)	10.6 (4.8; 0–19)	10.3 (4.6; 1–19)	.30
Male, %	53.7	50.2	.25
Race/ethnicity, %			< .001
Non-Hispanic White	17.5	36.8	
Non-Hispanic Black	37.0	19.5	
Non-Hispanic other	10.0	13.2	
Hispanic	34.7	30.3	
Missing	0.8	0.3	
Enrolled in public health insurance, %	98.1	98.9	.44
Physical, learning, or mental health limitations, %	4.6	3.0	.16
Ever been homeless or not had a regular place to live, %	4.6	1.9	.006
No. of children in household younger than 5 y, mean (SD; range)	1.8 (1.0; 1–7)	1.4 (0.6; 1–5)	< .001
No. of children in household between 5 and 17 y old, mean (SD; range)	1.0 (1.2; 0–6)	0.7 (1.1; 0–5)	< .001
No. of adults in household older than 17 y, mean (SD; range)	2.1 (1.0; 0–7)	2.2 (1.0; 1–9)	.004
Parent characteristics			
Age, y, mean (SD; range)	27.9 (7.1; 18–70)	28.5 (7.1; 18–62)	.18
Male, %	1.9	2.4	.53
Race/ethnicity, %			< .001
Non-Hispanic White	24.0	43.2	
Non-Hispanic Black	37.0	20.6	
Non-Hispanic other	8.6	7.4	
Hispanic	29.9	28.5	
Missing	0.6	0.3	
Spanish language speaker, %	25.9	23.7	.40
Nativity, %			.35
United States	71.6	73.2	
Mexico	21.3	18.3	
Central America	4.2	6.0	
Other	2.9	7.6	
Marital status, %			< .001
Single/never married	54.5	43.3	
Married/common-law marriage/cohabitating	38.4	50.1	
Separated/divorced/widowed	6.3	6.4	
Other/missing	0.8	0.1	
Education, %			.014
≤ some high school	31.5	24.7	
High school or equivalent	26.3	25.3	
Some college or 2-year college degree	34.9	38.8	
≥ 4-year (English) or 6-year (Spanish) college degree	7.1	11.0	
Don't know/missing	0.2	0.1	

Continued

available as a supplement to the online version of this article at http://www.ajph.org). After rate ratio adjustment for baseline dental care need, having a baseline dental visit, and the propensity score covariate, the mean number of dental visits among EHS children was 1.35 times (95% CI = 1.17, 1.55) the mean number among non-EHS children within the same cluster (Table 4).

DISCUSSION

To our knowledge, this is the first study to demonstrate that EHS participation increases overall dental care use among enrolled children. This increase was observed for preventive visits as opposed to treatment or emergency visits. Children enrolled in EHS not only had greater odds of having a preventive dental care visit but had more dental visits on average than a similar group of disadvantaged children not enrolled in the program. Notably, use of preventive dental care was more frequent among Medicaid-enrolled children in the control group (56%) than in the national Medicaid population (45%–48%).[10] Thus, the magnitude of the improvement in preventive dental care use among EHs children (79%) is even more significant.

Our study expands the literature on the EHS program's impact on oral health outcomes beyond the 2002 Early Head Start Research and Evaluation Project (EHSREP), which, to our knowledge, is the only other study on the effects of EHS enrollment on oral health.[18,24,30] Unlike our study, the EHSREP, a large-scale randomized controlled trial, did not reveal any effects of EHS on dental use. Several reasons might explain the difference in findings. The EHSREP was conducted during 1996 to 1999, when the EHS program was first being implemented. Performance standards were being developed for early education programs, and they did not prioritize oral services as they do now. Furthermore, professional guidelines recommending that children have their first dental visit at 1 year of age were not widely available at the time. Finally, the EHSREP did not provide EHS interventions with additional education and support

TABLE 1—*Continued*

Characteristic	EHS Group (n = 479)	Non-EHS Group (n = 699)	P
Government support, %			
Welfare, Work First, TANF, cash assistance	12.9	5.9	< .001
Food stamps	79.5	61.9	< .001
WIC	90.6	89.8	.59
Child support/alimony	16.9	11.2	.004
Child-care subsidy or education assistance	22.1	11.4	< .001
Housing assistance	16.3	7.0	< .001
Medicare or Medicaid	80.0	85.4	.026
Medicaid	48.9	40.9	.005
Employment status, %			
Works full time	21.7	18.9	.28
Works part time	16.3	19.0	.23
Looking for work	29.9	26.0	.14
In school/training	27.6	18.2	< .001
Keeping house	62.8	66.4	.23

Note. EHS = Early Head Start; TANF = Temporary Assistance for Needy Families; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children. Baseline data were collected from 2010–2012. As a result of rounding, percentages may not sum to exactly 100. *P* values are for the χ^2 test or *t* test comparing the EHS and non-EHS groups. Values from the "don't know" and "missing" categories were excluded from the χ^2 test, and, to satisfy test assumptions, categories were combined if the expected count for a particular cell was < 5.

related to oral health services, as was done in the ZOE study.

Our EHS findings are similar to results observed in at least 2 studies of Head Start, the comprehensive preschool program for low-income children aged 3 to 5 years.[14,31,32]

TABLE 2—Results of Unadjusted Analysis of the Impact of Early Head Start (EHS) Enrollment on Preventive, Treatment, Emergency, and Overall Dental Care Use After 24 Months: Zero Out Early Childhood Caries Study, North Carolina

Visit Type[a]	EHS Group (n = 479), %	Non-EHS Group (n = 699), %	OR (95% CI)[b]
Overall	81	59	3.5 (2.6, 4.6)
Preventive	79	56	3.4 (2.6, 4.6)
Treatment	8	9	0.9 (0.6, 1.4)
Emergency	2	2	0.7 (0.3, 1.7)

Note. CI = confidence interval; OR = odds ratio. Baseline data were collected from 2010–2012; 24-month follow-up data were collected from 2012–2014.

[a]At least 1 visit in given category.

[b]Odds ratio estimates for unadjusted random intercept models. A random effect was used to adjust for clustering within each of the 25 EHS programs.

For instance, the Head Start Impact Study, a large randomized controlled trial, showed that 69% of a cohort of 3-year-old children enrolled in Head Start received dental care in their first year of enrollment, as compared with 52% of children enrolled in school readiness initiatives other than Head Start.[14,31] A similar trend was observed in a 4-year-old cohort (73% vs 57%).[31] Overall, the differences reported in that study—16% to 17% higher rates of oral health service use among enrollees—were similar in magnitude to what we observed.[31] In another study involving a Medicaid-matched retrospective cohort design, rural children participating in South Carolina Head Start showed improvements in dental care use relative to children not enrolled in Head Start.[32]

Although Head Start has been shown to improve use of dental care among children 3 to 5 years old,[14,31] the positive impact of an early childhood educational program on use of preventive services among children younger than 3 years observed in our study provides important new information. Specifically, our results demonstrate the effectiveness of a strategy designed to increase exposures to preventive services during the critical period before dental caries is established.

We found that the percentages of children with reports of treatment and emergency visits were the same in our 2 experimental groups. We initially surmised that children enrolled in our study would need both preventive and treatment services because of their high risk of dental caries and the lack of science-based strategies to completely eliminate this risk. We further surmised that EHS participation would be likely to increase access to all types of needed services, including comprehensive treatment services, thus leading to our hypothesized higher treatment rates in the EHS group.

A number of reasons could explain the lack of complete support that our findings provide for our hypothesis. As observed in our study, EHS staff are able to provide services that increase preventive dental visits. Follow-up visits are often required to fully meet dental caries treatment needs. EHS staff likely are unable to overcome the many barriers that prevent low-income families from receiving comprehensive oral health care. Follow-up care requires parental cooperation and the availability of dentists who will provide care for young children enrolled in Medicaid, conditions that often are not met in a number of communities.

Two methodological challenges could affect interpretation of our study outcomes. We did not have a measure of unmet clinical need at follow-up, so we were unable to evaluate the appropriateness of the number of reported visits or their type. Because treatment and emergency visits were both infrequent in our study, a larger sample size might be needed to better detect differences in treatment visits between EHS and non-EHS groups if they exist. Future research will need to collect information on clinical as well as self-reported dental care need with larger samples.

Although we found that, on average, children enrolled in EHS had more dental visits than non-EHS children (2.0 vs 1.7), the number of visits over the 2-year study period was fewer than recommended in professional guidelines set forth by the American Academy of Pediatric Dentistry. Specifically, a child who is not at high risk for dental caries should have a preventive dental care visit every 6 months during a 2-year

TABLE 3—Results of Logit Models Assessing the Effects of Early Head Start Enrollment on Having 1 or More Dental Care Visits: Zero Out Early Childhood Caries Study, North Carolina

Model	Overall, OR (95% CI)	Preventive, OR (95% CI)	Treatment, OR (95% CI)	Emergency, OR (95% CI)
Early Head Start	2.46 (1.74, 3.48)	2.59 (1.84, 3.63)	0.67 (0.40, 1.11)	0.79 (0.29, 2.20)
Needed any dental care at baseline	8.26 (3.90, 17.49)	7.09 (3.60, 13.99)	1.91 (1.09, 3.36)	4.81 (1.96, 11.84)
Any dental care visits at baseline	2.68 (1.19, 6.01)	2.49 (1.15, 5.38)	3.05 (1.47, 6.34)	2.60 (0.56, 12.00)
Propensity score	2.41 (1.02, 5.73)	1.89 (0.82, 4.39)	2.00 (0.56, 7.12)	0.10 (0.0064, 1.61)
Constant	0.96 (0.63, 1.47)	0.91 (0.61, 1.37)	0.07 (0.04, 0.12)	0.035 (0.014, 0.091)
Random effect standard deviation	0.65 (0.43, 0.98)	0.60 (0.39, 0.92)	0.29 (0.10, 0.84)	. . .

Note. CI = confidence interval; OR = odds ratio. With the exception of emergency visits, which were infrequent, models included random effects for each of the 25 Early Head Start program clusters. Baseline data were collected from 2010–2012; 24-month follow-up data were collected from 2012–2014. The sample size was n = 1178.

period. More frequent preventive visits are recommended for high-risk children.[33] The average EHS child enrolled in our study had half or fewer of the recommended number of preventive dental visits, and the average non-EHS child had even fewer visits.

In our study, a marginalized negative binomial model was used for the first time in dental research to estimate the multiplicative increase in the mean number of dental visits among EHS children relative to the mean number among non-EHS children. This model performed similarly to the traditional zero-inflated negative binomial model in terms of the Akaike information criterion (with scores of 4340.1 and 4338.4, respectively). Furthermore, the sign and magnitude of the respective differential EHS effects were similar (data not shown). Nonetheless, the interpretations of these different model types are distinct. We selected the marginalized negative binomial regression model for our analysis because our interest was in the effects of EHS participation on the mean number of dental care visits in the overall child population of North Carolina as opposed to an unobserved subgroup (i.e., latent class) of children assumed to be "at risk" for having such visits in a standard zero-inflated negative binomial model.

Limitations

There are several limitations to this study. Lack of random assignment of parent–child dyads to the EHS and control groups could have biased our effect estimates. Although we used a Medicaid-matched control group and propensity scores to address observed confounders, the possibility of selection bias remains. In addition, we relied on self-reported data, which may have led to overestimation of preventive dental care use.[34] However, this overestimation may have been counterbalanced by crossover; that is, children in the non-EHS group participated in EHS and alternative early childhood

TABLE 4—Results of Marginalized Zero-Inflated Negative Binomial Model Assessing the Effects of Early Head Start (EHS) on Mean Increments in Dental Care Visits: Zero Out Early Childhood Caries Study, North Carolina

Variable	Parameter Estimate	Model-Based SE	Empirical SE	OR (95% CI)	RR (95% CI)
Probability of having an excess dental care visit					
EHS	−1.23**	0.22	0.25	0.29 (0.19, 0.46)	
Propensity score	0.03	0.56	0.56	1.03 (0.32, 3.29)	
Needed dental care at baseline	−4.98	7.78	11.45	0.01 (0.00, 66 529.45)	
Had a dental care visit at baseline	−1.20*	0.45	0.66	0.30 (0.12, 0.77)	
Constant	−0.59**	0.20	0.26	0.55 (0.37, 0.84)	
Overall mean number of dental care visits					
EHS	0.30**	0.068	0.063		1.35 (1.17, 1.55)
Propensity score	0.30	0.160	0.160		1.35 (0.98, 1.87)
Needed dental care at baseline	0.53**	0.040	0.061		1.69 (1.56, 1.84)
Had a dental care visit at baseline	0.42**	0.089	0.090		1.52 (1.26, 1.83)
Constant	0.31**	0.092	0.090		1.36 (1.13, 1.65)
Random effects variance components					
Standard deviation of excess zeros intercept	0.69**	0.13	0.014		
Standard deviation of mean model intercept	0.28**	0.061	0.054		
Correlation of random intercepts	−0.94**	0.078	0.061		
Overdispersion parameter	0.04	0.019	0.023		

Note. CI = confidence interval; OR = odds ratio; RR = rate ratio. ORs, RRs, and CIs are based on model empirical standard errors. Models included random effects for each of the 25 EHS program clusters (see Appendix B, available as a supplement to the online version of this article at http://www.ajph.org). Baseline data were collected from 2010–2012; 24-month follow-up data were collected from 2012–2014. The sample size was n = 1178.

*$P<.05$; **$P<.01$.

education programs. Such crossover would lead to underestimates of the effects of EHS participation on dental care use.

Public Health Implications

Gaining access to dental care services for young children in low-resource families before the onset of early childhood caries is often difficult. Our findings illustrate for the first time that comprehensive early childhood education programs such as EHS can improve dental care use, particularly use of preventive dental services, among infants and toddlers. Thus, these programs have the potential to reduce inequalities in oral health.

Additional studies are needed to identify the EHS program attributes associated with improved dental care use among children and, ultimately, whether these factors lead to improvements in clinical and psychosocial oral health outcomes. Such investigations can inform the design of future federal and state programs targeting vulnerable preschool-aged children and their families. AJPH

CONTRIBUTORS

J. M. Burgette conceptualized the article, conducted the data analysis, interpreted the results, and served as the lead writer. J. S. Preisser Jr contributed to the study conceptualization and design, conducted the data analysis, interpreted the results, and contributed to the writing. M. Weinberger and R. S. King contributed to the conceptualization of the study and revised the writing. J. Y. Lee contributed to the conceptualization of the study. R. G. Rozier originated and implemented the study, conceptualized the article, interpreted the results, and substantially revised the writing.

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HUMAN PARTICIPANT PROTECTION

This study was approved by the institutional review board of the University of North Carolina at Chapel Hill. Informed consent was obtained from all parent–child dyads.

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