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Absence of a Moderating Effect of Parent Health Literacy on Early Head Start Enrollment and Dental Use

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Abstract

Objectives—To examine the moderating effect of parents' health literacy (HL) on the effectiveness of North Carolina Early Head Start (EHS) in improving children's dental use.

Methods—Parents of 479 children enrolled in EHS and 699 Medicaid-matched parent-child dyads were interviewed at baseline when children were approximately ten months old and 24 months later. We used in-person computer-assisted, structured interviews to collect information on sociodemographic characteristics, dental use, and administer the Short Assessment of Health Literacy (SAHL-S&E). This quasi-experimental study tested whether the interaction effect between EHS and parents' HL was associated with dental use. Logit (any use) and marginalized zero-inflated negative binomial count models (number of dental visits) included random effects to account for clustering and controlled for baseline dental use, dental need, survey language and a propensity score covariate.

Results—Nineteen percent of parents in EHS had low literacy compared to 12% of parents in the Non-EHS group ($P<0.01$). The interaction term between EHS and parent's HL was not significant

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in the adjusted logit model (ratio of aOR's 0.98, 95% CI: 0.43–2.20) or the adjusted count model (ratio of aRR's 0.88, 95% CI: 0.72–1.09).

Conclusions—Parents in EHS had a higher prevalence of low HL compared to non-EHS parents. Parents' HL did not moderate the relationship between EHS and child dental use, suggesting that EHS results in similar improvements in dental use regardless of parent's HL levels.

Keywords

Early Intervention; Health Literacy; Child Health Services; Dental Care for Children; Access to Health Care

Introduction

Health literacy (HL) is a complex construct that encapsulates a range of skills needed to communicate and function within the health system. It is defined as “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” (1). Nationally, 88% of the population lacked proficient HL in 2003 (2). Low HL is associated with a large number of negative health outcomes, including poor access to medical care, increased hospitalizations and fewer preventive visits (3).

HL, not specific to oral health, is an important consideration when studying the effectiveness of social programs. Enrollment forms for social programs, such as Medicaid and the Children's Health Insurance Program, are often written above the 10th-grade level and thereby impact the enrollment of families with low HL (4,5). Once enrolled, families with low HL can face additional challenges to navigating the benefits of social programs. To the authors' knowledge, it is unknown whether families with low HL are able to fully benefit from their participation in social programs to the same extent as families without low HL.

Health-related interventions often target individuals and families who are at increased risk of low HL. Systematic reviews find varying levels of success in these interventions achieving desired outcomes among those with low HL (6,7). The studies on which these reviews are based and others often assume low-literacy due to the sociodemographic characteristics of the study population or include measures of HL as confounders to control for experimental group imbalances (8). Few studies have examined the moderating effects of HL on the effectiveness of the health interventions (9,10). But among those studies that have been done, the direction of the moderation effects of HL on the effectiveness of interventions was not straightforward: the intervention had a greater effect for participants with low HL in one study (11), was inconsistent across different outcomes in some studies (12,13) and did not differ by literacy levels in others (14–16).

Early Head Start is a nationwide comprehensive early education program for low-income families and children birth to 3 years of age. It operates according to comprehensive Federal performance standards that integrate oral health (tooth-brushing with fluoridated toothpaste, oral health education and determination of a child's oral health status by a dental professional) into early education activities (17). Greater than 90% of families enrolled in

EHS are insured by Medicaid, which is a public insurance program for low-income families and individuals (18).

The “Zero Out Early Childhood Caries” (ZOE) study is evaluating the effects of Early Head Start (EHS) enrollment on oral health outcomes. Previously, we reported that being enrolled in EHS had a strong positive effect on dental use of children younger than 3 years of age (19). However, it is unknown whether the effect of EHS on dental use is influenced by parents’ HL. Many parents in EHS are particularly vulnerable to having low HL because they are young and have low incomes and education attainment, each of which is associated with low HL (20). The purpose of this study was to determine whether HL influences the effectiveness of EHS in improving parent-reported child use of dental health services. We hypothesized that parents’ low HL would have an attenuating effect on the impact of EHS on oral health outcomes such as dental use.

Methods

Overview of study design and data source

We used data from the ZOE study, a pre-post 24-month longitudinal prospective study. The ZOE study is quasi-experimental, in that the oral health outcomes of young children in the EHS program were compared with a control group of children not enrolled in EHS. Teachers and staff in EHS programs received minimal training in oral health and communication techniques to bolster awareness and implementation of EHS federal oral health performance standards. These performance standards include daily tooth-brushing with fluoridated toothpaste, oral health education by EHS teachers, and the determination of a child’s oral health status by a dental professional within 90 days of entry into the program. The study was approved by the Institutional Review Board at the University of North Carolina at Chapel Hill.

Study population and data collection procedures

Subjects were recruited to the study through a 3-step process previously described in detail (19,21). The sequential steps were: (1) enrollment of EHS programs; (2) enrollment of parent-child dyads within EHS programs; and (3) enrollment of community-matched parent-child dyads to serve as controls. In step one, all North Carolina EHS programs were invited to participate and all except one were enrolled. In step two, parents of EHS children younger than 19 months of age from all participating EHS programs were recruited by the research team. In step three, Medicaid-enrolled children of the same age, language (English or Spanish), and geographic area (ZIP codes) as enrolled EHS parent-child dyads were recruited as the control group through direct mailings from the North Carolina Medicaid program. The sample yielded EHS and Non-EHS parent-child dyads clustered within 25 of the 26 EHS programs in the state.

Parents were interviewed in-person by trained interviewers using computer-assisted, structured interview techniques at baseline (mean child age ~10 months) and approximately 24 months later, which coincided with the end of enrollment eligibility for the EHS program

(children were ~36 months old). The study design is described in detail in previous publications (19,21).

Conceptual framework

We used a HL conceptual model developed by Nutbeam (2008) to guide our study (22). In this model, HL is a “risk factor” for poor health that needs to be identified and appropriately managed through both environmental and communication strategies. The model suggests that low HL can impact health outcomes among individuals engaging in social programs. Specifically, EHS programs can provide: 1) an environment that is sensitive to the needs of individuals with low HL; 2) quality personal interactions between EHS families and teachers; and 3) education by EHS teachers that is tailored to the needs and capacities of EHS families. This supportive environment with quality interpersonal communication is more likely to result in EHS families meeting the oral health outcomes meant to be achieved through EHS federal oral health performance standards than otherwise. Thus, EHS may be a vehicle to improve child use of oral health services by accommodating parents’ HL levels. The direct effects of EHS family-centered program activities on the child’s dental use are supported further by an early education and childcare framework proposed by Friedman-Krauss and Barnett (23).

Measures

The main independent variable, EHS enrollment, was a binary variable (enrolled, not enrolled) supplied by EHS staff and confirmed by the parent at baseline. The dependent variable, overall dental use of any type by the child, was analyzed as both a binary and count variable in separate analyses. The binary outcome was determined by a positive response at follow-up to the question: “Has your child ever been to a dentist or dental clinic?” The count variable was the number of lifetime dental visits for the child using parent self-report at the follow-up interview.

The moderating variable, HL, was measured at baseline using the Short Assessment of Health Literacy – Spanish and English (SAHL-S&E), an 18-item word recognition and comprehension test (24). The number of correct items provided a continuous score ranging from 0 to 18. At time of data collection, SAHL-S&E was the only valid and reliable HL instrument available for Spanish-speaking populations that was practical to administer in studies with large sample sizes (24). Additionally, the SAHL-S&E was validated in a low-income population and had an established cut-off to identify families with low HL (SAHL-S&E 14) (24).

We included two baseline covariates in the analytical models because of their potential impact on future dental use: dental need and dental use between birth and the baseline interview. Dental need was self-reported by the parent as a binary variable, determined as a positive response to the question, “During your child’s life, has he or she ever needed dental care or check-ups?” Dental use was also a binary variable determined as parents’ positive response to the question, “Has your child ever been to a dentist or dental clinic?”

Analytical approach

Descriptive Analyses—We compared the distribution of the children’s demographic characteristics and parents’ HL by EHS group using t-tests (for continuous measures) and chi-square (for categorical measures).

Unadjusted Analyses—We examined the unadjusted relationship between EHS and dental use, stratified by parent’s HL (low vs. not low). We performed the Breslow-Day test for homogeneity of the odds ratio to determine whether the odds ratios for dental use are different across two strata: low HL or not low HL. We considered $P < 0.05$ as statistically significant.

Adjusted Binary Models—We analyzed the association between EHS and dental use with multivariate logistic regression (Eqn 1). The model included an interaction term between HL and EHS, β_7 , to test for the moderating effect of HL. When used as an interaction term, SAHL-S&E was treated as a binary variable for low HL versus other literacy levels (SAHL-S&E ;14) (24). In addition to EHS group, literacy level and their interaction term, we included baseline dental use, baseline dental need, survey language and a generalized boosted model propensity score covariate (25) in logit models as *a priori* confounders. The propensity score adjusted for 47 observed characteristics that may be imbalanced between the EHS and Non-EHS samples, which, in turn, may confound our estimates of the impact of EHS enrollment on dental use (25). We controlled for clustering of subjects within EHS programs and estimated the impact of EHS on dental use using random effects.

The logistic regression model used to test the interaction effect between EHS enrollment and low parent HL, β_7 , is illustrated in Eqn 1, where P_{ij} is the probability of receipt of children’s dental services at follow-up for the j th child in the i th EHS program cluster conditional on the cluster-specific random effect, b_i .

$$\text{logit}[P_{ij}] = \beta_0 + \beta_1 x_{1ij} + \beta_2 x_{2ij} + \beta_3 x_{3ij} + \beta_4 x_{4ij} + \beta_5 x_{5ij} + \beta_6 x_{6ij} + \beta_7 x_{1ij} x_{6ij} + b_i \quad \text{Eqn 1}$$

x_{1i} = Early Head Start enrollment (treatment indicator, dichotomous)

x_{2ij} = Dental use at baseline (Yes/No, dichotomous)

x_{3ij} = Dental need at baseline (Yes/No, dichotomous)

x_{4ij} = Survey language (English/Spanish, dichotomous)

x_{5ij} = Generalized boosted model propensity score (continuous)

x_{6ij} = Low parent health literacy (Short Assessment of Health Literacy – Spanish & English 14, dichotomous)

Adjusted Count Models—We used a marginalized zero-inflated negative binomial count model to examine whether parent HL moderated the relationship between EHS and the number of dental visits (26). The marginalized zero-inflated negative binomial count model

with random effects used in this study is defined in a previous publication without the interaction effect (19). The benefit of using a marginalized model over a traditional zero-inflated model is that it provides interpretable covariate effects that are parameterized directly on the overall mean (inclusive of “excess zeros”), accounts for overdispersed distributions of counts with a significant number of zeros, and avoids the conceptual and interpretation pitfalls of zero-inflated models in dental research (26). We included interaction terms defined in the same manner and with the same covariates as in the adjusted logit models.

Results

The study enrolled 1,567 child-parent dyads, an estimated 60% of the eligible EHS sample and 9% of the Non-EHS comparison sample. Two-year follow-up interviews were completed with 468 parents from EHS programs and 688 Non-EHS controls. Baseline characteristics of the EHS and Non-EHS children were similar with respect to age, gender, enrollment in public health insurance, and physical, learning, or mental health limitations; however, more children in EHS had been homeless and were minority race and ethnicity compared to children not enrolled in EHS (Table 1). On average, families in EHS also had more children and fewer adults in the household compared to Non-EHS children (Table 1).

Dental use

The prevalence of any dental use was significantly higher in the EHS group compared to the Non-EHS group (Table 2: EHS=81%; Non-EHS=59%, $P<0.01$). Similarly, there was a significant difference in the mean number of dental visits between children in the EHS and Non-EHS groups ($P<0.01$) (Table 2: EHS=2.58; Non-EHS=1.66, $P<0.01$).

Moderating Effect of Health Literacy

The prevalence of low HL was 15% overall: 19% for the EHS group and 12% for the Non-EHS group (Table 2). Although there was no statistically significant difference in the prevalence of dental use between parents who did or did not have low HL ($P>0.05$), we continued to observe a difference in the prevalence of dental use between EHS and Non-EHS groups when stratified by parents who had or did not have low HL ($P<0.01$) (Table 2: Low HL sample: EHS=82%, Non-EHS=63%, $P<0.01$. Not Low HL sample: EHS=81%, Non-EHS=58%, $P<0.01$). Further, there was no statistical evidence of effect modification of the parents' low HL on the EHS-dental use relationship (Breslow-Day χ^2 $P=0.78$). In the adjusted logit model, the interaction term between EHS and low parent HL did not have a statistically significant effect on any dental visits (ratio of aOR's=0.98; 95% CI: 0.43, 2.20) (Table 3).

We found a statistically significant difference in the mean number of child dental visits between EHS and Non-EHS groups in both the Low HL group and the Not Low HL group (Table 2: Low HL sample: ratio of EHS to Non-EHS mean: 1.30, $P<0.05$; Not Low HL sample: ratio of EHS to Non-EHS mean: 1.60, $P<0.01$). In the adjusted count model, the interaction between low parent HL and EHS group was not significant, suggesting that

parent HL may not be an effect modifier (ratio of aRR's=0.88; 95% CI: 0.72, 1.09) (Table 4).

Discussion

Previously, we reported North Carolina EHS to be effective in promoting the use of dental services by enrolled children, but only partially so (19). We found EHS enrollment was associated with a 17% increase in the probability of having one or more dental visits while enrolled in the program compared to non-enrollment. Unexpectedly, the EHS effect was for preventive visits only, with no effect on treatment visits. Further, the mean number of visits for children in both the EHS and Non-EHS groups fell short of the recommended number of preventive visits for children. Because dental use was improved by EHS enrollment, but still not to recommended levels, we explored the potential for parent HL to be a barrier to dental use.

Based upon our conceptual model and previous literature (3,27), we hypothesized that the effect of EHS on child dental use would be attenuated in families where parents had low HL (~15% of our sample) compared to families where parents did not have low HL. Our rationale was that low HL might pose challenges to families accessing dental care; and that these challenges would be difficult for EHS programs to completely overcome with available resources. We explored the moderating impact of low parent HL because we sought to understand whether the increase in dental use seen for EHS families was less pronounced when parents had low HL and additional efforts might be needed to overcome them.

However, our hypothesis was not supported. We did not detect a statistically significant difference in the effect for EHS on dental use for parents with and without low HL, suggesting that improvements in children's dental use through EHS programs impact on families are not attenuated by whether or not the parent has low HL. This finding implies that EHS is able to accommodate parents with low HL resulting in more dental use among the low-literacy EHS parents compared to Non-EHS parents who had better literacy levels. With both a higher prevalence of low parent HL and a higher prevalence of children's dental use in the EHS group, we posit that EHS has an effect through two primary pathways involving EHS staff: (1) facilitation of dental appointments; and (2) use of appropriate parent HL communication techniques. EHS programs provide a supportive environment in which EHS staff refer and facilitate scheduling of child visits to dental practices. Facilitating dental visits for young children appears to benefit families of all literacy levels. These EHS activities might overcome challenges to using oral health information to make dentist appointments by connecting EHS families with dental providers for all families regardless of HL.

Moreover, HL is a priority consideration in the development of EHS written materials and verbal communication techniques (28,29). EHS staff and teachers may assume low HL and, as such, use universal communication techniques for all families. As an education program through which benefits can be delivered to socioeconomically vulnerable families, EHS focuses on the importance of delivering HL-appropriate messages related to cognitive, social and behavioral development for the parent and the child.

Notably, EHS has HL-related competencies for staff and supervisors who work with families that support interactive literacy activities between parents and their children at home and in the community, as well as coordinating training and educational opportunities for parents related to family literacy (28). The Head Start Office created a Health Literacy Toolkit with an oral health section to aid in the partnership between families and EHS staff members in health care decision-making (29).

The current study is the first to investigate the impact of low parent HL on the relationship between EHS enrollment and child dental use. We found that the oral health services provided by EHS can support families with different levels of literacy as they navigate the health system in order to obtain, process, and understand basic oral health information and access oral health services. Moreover, this study adds to the growing literature on the health benefits of comprehensive early childcare education (30).

Our findings on the absence of effect modification from HL levels are consistent with some previous literature (9,14–16). Evidence suggests that intensive interventions can improve health outcomes among low HL populations (6–8). One systematic review found that intensive self-management interventions reduced hospitalizations and disease severity (7). While not evaluating whether an intervention was more or less effective for families with low HL, there is evidence that HL-related interventions can improve outcomes in an early childhood education program (8). Stockwell and colleagues (2014) found that an upper respiratory infection-related health literacy intervention embedded into EHS programs reduced pediatric emergency department use and decreased adverse care practices related to medication dosing (8). In contrast to the present study, where preventive and treatment dental use is a desirable outcome, this study examined emergency visits, which is an undesirable outcome. Additionally, the study by Stockwell and colleagues (2014) focused on the effectiveness of the intervention on use and practices in an EHS population; and did not examine whether there was a significant moderating effect for HL on intervention impacts.

Limitations

There are several limitations of this study. First, dyads were not randomized to EHS; however, we used a Medicaid-matched control group and propensity scores to reduce the potential for biased estimates of effect. Second, the study was conducted in only one state and generalizability of findings to other sections of the United States may be limited. Third, the moderating effect of parent HL may be small, requiring a large sample size to detect.

Finally, we used an instrument that measured HL and not oral health literacy (OHL). We believe that a general HL instrument was acceptable for this study because of the following reasons: 1) previous studies on HL and oral health outcomes have used a general HL instrument or developed a combined HL-OHL instrument (10,31); 2) it is likely that many of the skills required to access and use information may be common to both medical and dental health care systems; 3) the EHS treatment group represents a comprehensive social program that undertakes a set of activities designed to improve social, medical, and cognitive outcomes beyond the scope of oral health; and 4) a fully-tested OHL instrument for Spanish-speakers was not available at the time of the study (32); and we were unsuccessful in

developing a single instrument that could be used for both English and Spanish speakers using Item Response Theory.

Future research

Future research is needed to understand the influence of HL on other child dental outcomes, such as oral hygiene practices, which may be more susceptible to modification by a parent's HL levels. Additionally, future research is needed to better understand the ways in which EHS addresses low parent HL. Finally, future research is needed to develop a single OHL instrument that can be used for both English and Spanish speakers.

Conclusions

Access to dental services for low-resource families with very young children is challenging, particularly so in families where parents have low HL. EHS is a national program that can reach children from birth to age three. Our findings illustrate that this comprehensive early childhood education program can improve dental use for children, including those with parents who have low HL. To our knowledge, this is the first study to provide evidence that an early childhood education program enrolling children younger than three years of age can have similar improvements for parents with and without low HL.

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Table 1

Baseline Child Characteristics of the Zero-Out Early Childhood Caries Study Population, by Early Head Start (EHS) and non-Early Head Start (Non-EHS) Groups.

Characteristic	EHS (n=479)	Non-EHS (n=699)	p-value [‡]
	%	%	
Age (months) [mean, SD (range)]	10.6, 4.8 (0–19)	10.3, 4.6 (1–19)	0.297
Gender			0.246
Male	53.7%	50.2%	
Female	46.3%	49.8%	
Race and ethnicity			0.000
Non-Hispanic White	17.5%	36.8%	
Non-Hispanic Black	37.0%	19.5%	
Non-Hispanic Native American	2.3%	1.1%	
Non-Hispanic Other, Single Race/Ethnicity	0.2%	1.0%	
Non-Hispanic Other, Multiple Races/Ethnicities	7.5%	11.0%	
Hispanic	34.7%	30.3%	
Missing	0.8%	0.3%	
Language			0.403
English	74.1%	76.3%	
Spanish	25.9%	23.7%	
Enrolled in public health insurance			0.441
Yes	98.1%	98.9%	
No	1.7%	1.1%	
Missing	0.2%	0.0%	
Physical, learning, or mental health limitations			0.159
Yes	4.6%	3.0%	
No	94.6%	95.6%	
Don't know	0.8%	1.4%	
Ever been homeless or not had a regular place to live			0.006
Yes	4.6%	1.9%	
No	95.0%	98.0%	
Don't know	0.4%	0.1%	
Number of children in the household under 5 years-old [mean, SD (range)]	1.8, 1.0 (1–7)	1.4, 0.6 (1–5)	<0.001
Number of children in the household between 5 and 17 years-old [mean, SD (range)]	1.0, 1.2 (0–6)	0.7, 1.1 (0–5)	0.0008
Number of adults in the household over 17 years-old [mean, SD (range)]	2.1, 1.0 (0–7)	2.2, 1.0 (1–9)	0.0040

N=number of subjects in stratum, SD=standard deviation,

* Due to rounding, percentages may not add to exactly 100%.

[‡]The p-values are for chi-square tests or t-tests comparing EHS and non-EHS groups. For the chi-square test, “don't know” and “missing” values were excluded, and categories were combined if the expected count for a particular cell was less than five to satisfy the test's assumptions.

Table 2

Overall Dental Use at 24-month follow-up in the Zero-Out Early Childhood Caries Study, by Early Head Start (EHS) and Parent's General Health Literacy (N=1,178).

Parent Health Literacy [∞]	EHS Group	Overall Dental Use (n, %)	Number of Overall Dental Visits (Mean, SD, Range)
Low Parent Health Literacy	EHS (<i>n</i> =90)	74 (82%) ⁺⁺	2.73 [*] (SD=1.99) Range=0–8
	Non-EHS (<i>n</i> =87)	55 (63%) ⁺⁺	2.10 [*] (SD=2.14) Range=0–10
	Both (<i>n</i> =177)	129 (73%) [∞]	2.42 [†] (SD=2.08) Range=0–10
Not Low Parent Health Literacy	EHS (<i>n</i> =389)	314 (81%) ⁺⁺	2.55 ^{**} (SD=2.02) Range=0–11
	Non-EHS (<i>n</i> =612)	357 (58%) ⁺⁺	1.59 ^{**} (SD=1.86) Range=0–12
	Both (<i>n</i> =1,001)	671 (67%) [∞]	1.96 [†] (SD=1.98) Range=0–12

[∞] Short Assessment of Health Literacy (SAHL). Low Parent Health Literacy was defined as a SAHL score of 14 and under (SAHL = 14).

⁺⁺ Significant difference between the EHS and Non-EHS groups for the prevalence of overall dental visits at the 0.01 significance level using a chi-squared test.

^{*} Significant difference between the EHS and Non-EHS groups for the number of overall dental visits at the 0.05 significance level using a t-test.

^{**} Significant difference between the EHS and Non-EHS groups for the number of overall dental visits at the 0.01 significance level using a t-test.

[†] Significant difference between the Low Parent Health Literacy and Not Low Parent Health Literacy groups at the 0.01 significance level using a t-test.

[∞] No significant difference between the Low Parent Health Literacy and Not Low Parent Health Literacy groups at the 0.05 significance level using a chi-squared test.

Note: We cannot reject the hypothesis that the association between EHS and dental use is the same in the two parent health literacy strata at the 0.05 significance level using the Breslow-Day test for homogeneity of the odds ratio, *P*=0.78.

Table 3

Logit Model on the Effect of Early Head Start Enrollment on Any Dental Visits with and without the Interaction Effect between Early Head Start and Low Parent General Health Literacy (N=1,178).

	Any Dental Visits	
	OR (95% CI)	OR (95% CI)
Early Head Start	2.53 ** (1.79, 3.59)	2.54 ** (1.76, 3.69)
Had a Dental Visit at Baseline	2.65 * (1.17, 5.99)	2.64 * (1.17, 5.98)
Needed Dental Care at Baseline	8.45 ** (3.98, 17.91)	8.45 ** (3.98, 17.91)
Survey Language	0.56 ** (0.39, 0.79)	0.55 ** (0.38, 0.79)
Propensity Score	2.10 (0.89, 4.99)	2.12 (0.89, 5.04)
Low Parent General Health Literacy [†]	--	0.95 (0.57, 1.59)
Interaction Effect between Early Head Start and Low Parent General Health Literacy [†]	--	0.98 (0.43, 2.20)
Constant	1.60 (0.96, 2.66)	1.61 (0.96, 2.71)
Standard Deviation of Random Effects	0.58 (0.38, 0.90)	0.58 (0.38, 0.90)

* P<0.05,

** P<0.01, OR=odds ratio, CI=confidence interval

[†] Short Assessment of Health Literacy (SAHL). Low Parent Health Literacy was defined as a SAHL score of 14 and under (SAHL ≤ 14).

Note: Model included random effects for each of the 25 Early Head Start program clusters.

Table 4

Marginalized Zero-Inflated Negative Binomial Model on the Effect of Early Head Start (EHS) on the Mean Increment in Dental Visits (N=1,178).

	Parameter ^{††}	Exponentiation of Parameter	95% CI [‡]
Probability of Having an “Excess Zero”^Ω		Odds Ratio	
EHS	α_1	0.31 **	0.19, 0.54
Had a Dental Visit at Baseline	α_2	0.40	0.18, 0.89
Needed Dental Care at Baseline	α_3	0.04	0.00, 2.83
Survey Language	α_4	1.26	0.66, 2.43
Propensity Score	α_5	0.86	0.26, 2.83
Low Parent General Health Literacy [‡]	α_6	1.14	0.62, 2.10
Interaction Effect between EHS and Low Parent General Health Literacy [‡]	α_7	0.96	0.34, 2.75
Constant	α_0	0.47 *	0.28, 0.78
Overall Mean Number of Dental Visits		Rate Ratio	
EHS	β_1	1.36 **	1.20, 1.55
Had a Dental Visit at Baseline	β_2	1.46 **	1.22, 1.76
Needed Dental Care at Baseline	β_3	1.69 **	1.55, 1.84
Survey Language	β_4	0.69 **	0.59, 0.82
Propensity Score	β_5	1.35	0.98, 1.86
Low Parent General Health Literacy [‡]	β_6	1.07	0.87, 1.31
Interaction Effect between EHS and Low Parent General Health Literacy [‡]	β_7	0.88	0.72, 1.09
Constant	β_0	1.79 **	1.48, 2.15
Random Effects variance components		Estimate[∞]	Empirical Standard Error
Standard deviation of excess zeros intercept	σ_1	0.65 **	0.14
Standard deviation of mean model intercept	σ_2	0.23 **	0.07
Correlation of random intercepts	ρ	-0.95 **	0.08
Overdispersion parameter	ϕ	0.02	0.02

* P<0.05,

** P<0.01, CI=confidence interval,

^Ω As in a traditional zero-inflated count model, the first model part, the probability of an “excess zero,” accounts for children with zero dental visits whose number is in excess of that expected under the negative binomial distribution. Otherwise, interpretations of effects target the “Overall Mean Number of Dental Visits.”

[‡] Odds ratios, rate ratios and confidence intervals are based on the model’s empirical standard errors.

^{††} Parameters are defined as in the model expression in the appendix of Burgette et al., 2017.

[∞] Estimate is the parameter without exponentiation.

[‡] Short Assessment of Health Literacy (SAHL). Low Parent Health Literacy was defined as a SAHL score of 14 and under (SAHL ≤ 14).

Note: Model included random effects for each of the 25 EHS program clusters.

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