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Racial Disparities in Developmental Delay Diagnosis and Services Received in Early Childhood

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Abstract

Background and objectives: Racial disparities in diagnosis and receipt of services for early childhood developmental delay (DD) are well known but studies have had difficulties distinguishing contributing patient, healthcare system and physician factors from underlying prevalence. We examine rates of physician diagnoses of DD by preschool and kindergarten entry controlling for a child's objective development via scoring on validated developmental assessment along with other child characteristics.

Methods: We used data from the preschool and kindergarten entry waves of the Early Childhood Longitudinal Study, Birth Cohort. Dependent variables included being diagnosed with DD by a medical provider and receipt of developmental services. Logistic regression models tested whether a child's race was associated with both outcomes during preschool and kindergarten while controlling for the developmental assessments, as well as other contextual factors.

Results: Among 7,950 children, 6.6% of preschoolers and 7.5% of kindergarteners were diagnosed with DD. Of preschool children with DD, 66.5% were receiving developmental

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services, while 69.1% of kindergarten children with DD were receiving services. Children who were Black, Asian, spoke a primary language other than English and had no health insurance were less likely to be diagnosed with DD despite accounting for cognitive ability. Black and Latinx children were less likely to receive services.

Conclusion: Racial minority children are less likely to be diagnosed by their pediatric provider with DD and less likely to receive services despite accounting for a child's objective developmental assessment. The pediatric primary care system is an important target for interventions to reduce these disparities.

Keywords

developmental delay disparities; Early Childhood Longitudinal Study Birth cohort; Early intervention

Background

Developmental disabilities affect approximately 16% of children and early identification of delay and participation in developmental services is associated with individual and societal benefits.^[1-2] The pediatric primary care system plays an important role in caring for children with developmental delay (DD), including providing developmental screening and surveillance, facilitating a timely diagnoses, addressing any associated medical conditions and linking families to services^[3]. This is particularly true prior to school entry, as pediatricians are often the only trained provider routinely assessing young children's development.

There exist multiple racial and ethnic disparities along the continuum of DD diagnosis and management. These disparities likely represent the culmination of interconnecting variables, including patient factors, health care system factors, and clinical encounter factors.^[4] Minority children are less likely to be diagnosed with any form of DD as well as a number of specific DD conditions.^[1-5] For example, Latinx, Black and Asian children with autism spectrum disorder and attention deficit hyperactivity disorder are diagnosed at a later age and with more severe symptoms than white children.^[6-8] Additionally, racial/ethnic minority children are more likely to face disparities in the processes leading to a potential diagnosis, as they are less likely to access high quality primary care services and their parents are less likely to be asked about developmental concerns.^[9-10] Finally, these children are less likely to receive developmental services and less likely to be placed into special education.^[11-12] Many of the studies that have described disparities in DD diagnosis and use of services have difficulty distinguishing whether these differences are driven by true epidemiologic differences in prevalence of developmental delay versus health care system or clinical encounter factors leading to under-recognition or poor management of existing delays.^[13-15]

We take a unique analytic approach that allows us to more closely examine this distinction. By accounting for objective measures of a child's development (via score on validated developmental assessment tool), access to well child care, and other contextual factors, we test whether differences in parental report of receiving a DD diagnosis by a doctor

across racial and ethnic groups, are largely driven by differences in the prevalence DD versus patient, health care system, clinical encounter factors. Identifying the factors driving these racial and ethnic disparities is critical to developing interventions to eliminate those disparities moving forward.

METHODS

Data Source and Analytic Sample

We utilized the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) database, a nationally representative sample of children born in the United States in 2001 followed longitudinally through kindergarten entry in 2006–2008. The analytic sample included 7,950 children with complete data on the primary outcome (diagnosis by preschool), developmental trajectory (preschool models), and preschool sampling weight. Data were collected from birth certificates, parent and guardian interviews, direct child assessments, and reports from childcare providers and teachers when children were approximately 9 months, 2 years, 4 years (preschool wave), and 5–6 years old (kindergarten entry waves). Approximately 14,000 births were sampled for the study and yielded 10,688 cases in the first wave, for a response rate of 76%. Response rates in subsequent waves were 91%–93%. There was a planned 15% reduction in the sample prior to the kindergarten entry waves; 6,900 children in the kindergarten entry waves completed direct assessments.

Measures

Outcomes—Diagnosis of DD by preschool and diagnosis of DD by kindergarten entry were assessed with items from the 2-year, preschool, and kindergarten entry parent interviews. During each interview, parents were asked “Has a doctor ever told you that (child) has the following conditions?” Delay in learning to talk, another DD, and mental retardation were listed among the possible conditions in the 2-year interview. In addition, another DD, mental retardation, and autism or pervasive developmental disorders (PDD) were listed among the possible conditions in the preschool interview and kindergarten entry interviews. Children were considered to have a diagnosis by preschool if parents answered yes to at least one of the above conditions from the 2-year interview or preschool interview. Children were considered to have a diagnosis by kindergarten entry if parents answered yes to at least one of the conditions from the 2-year interview, preschool interview, or kindergarten entry interviews.

Services by preschool and services by kindergarten entry were assessed with items from the 2-year, preschool, and kindergarten entry parent interviews. During each interview, parents were asked “For each service, please tell me if (child) or your family received this service to help with (child’s) special needs. Has anyone in your household ever received...” Speech or language therapy and special classes with other children were listed among the possible services in the interviews. In addition, parents were asked, “Is (child) currently participating in an early intervention program or regularly receiving any services for (his/her) conditions from...” The local school district, a state or local health or social service agency, a doctor, clinic, or other health care provider, and other sources were listed as the possible services in the interviews. Children were considered to have services by preschool if parents answered

yes to at least one of these services from the 2-year interview or preschool interview. Children were considered to have services by kindergarten entry if parents answered yes to at least one of these services from the 2-year interview, preschool interview, or kindergarten entry interviews.

Child Characteristics—We identified child characteristics likely associated with the diagnosis of a DD and receipt of services. Measures included child's race/ethnicity (non-Hispanic White, African American, Hispanic or Latino, Asian, other, multiracial), highest level of parental education (less than high school diploma, high school diploma or vocational degree, some college, bachelor's degree or higher), child's sex, household income and poverty status, urbanicity (rural, urban), primary home language (English, non-English), health insurance (yes, no), number of well-child visits between interviews, center-based child care attendance (yes, no) and developmental trajectory. Health insurance at the 9-month interview, 2-year interview, and preschool interview were included in the preschool models and the kindergarten entry models. The kindergarten entry models also included health insurance at the kindergarten 2006–2007 interview. The number of well-child visits between the 9-month interview and 2-year interview (less than two, at least two) and the number of well-child visits between the 2-year interview and preschool interview (zero, at least one) were included in the preschool models and kindergarten entry models. The kindergarten entry models also included the number of well-child visits between the preschool interview and kindergarten entry interview (one, at least one). Center-based child care attendance at the 9-month interview, 2-year interview, and preschool interview were included in the preschool models and the kindergarten entry models.

We created a 4-category variable capturing if children scored in the lowest decile on developmental assessments over time, allowing us to account for both their developmental status at the time of each assessment, as well as their developmental trajectory over time. For the preschool models, developmental trajectory was based on the Bayley Short Form-Research Edition (BSF-R) mental scale score at the 9-month and 2-year interviews with scoring as follows: 0 = both scores > 10th percentile, 1 = 9-month score > 10th percentile and 2-year score > 10th percentile, 2 = 9-month score > 10th percentile and 2-year score < 10th percentile, and 3 = both scores < 10th percentile. For the kindergarten models, developmental trajectory was based on the BSF-R mental scale score at the 2-year interview and early reading and math item response theory (IRT) scale scores at the preschool interview. We created a 4-category variable to assess whether a child had DD between preschool and kindergarten as follows: 0 = 2-year BSF-R mental scale score > 10th percentile and 4-year old preschool early reading and math scale scores > 10th percentile, 1 = 2-year BSF-R mental scale score < 10th percentile and 4-year-old preschool early reading and math scale scores > 10th percentile, 2 = 2-year BSF-R mental scale score > 10th percentile and 4-year-old preschool early reading or math scale score < 10th percentile, and 3 = 2-year BSF-R mental scale score < 10th percentile and preschool early reading or math scale score < 10th percentile. This variable distinguished children consistently scoring above the bottom decile from children scoring in the bottom decile.

Analytic Approach—To identify child characteristics associated with the likelihood of receiving a DD diagnosis at both the Preschool wave and Kindergarten wave, we conducted a weighted multivariable logistic regression model of diagnosis by preschool and diagnosis by kindergarten on child characteristics, respectively. To identify child characteristics associated with receipt of developmental support services after a diagnosis has been made, we conducted weighted multivariate logistic regression models of receipt of services by preschool and receipt of services by kindergarten on the sample of children who had a diagnosis of DD by preschool and by kindergarten, respectively. Both models included all of the child characteristics described above, and controlled for the child’s developmental status. Unweighted sample sizes were rounded to the nearest 50, as required by the National Center for Education Statistics. Analyses were conducted using the “svy” suite of commands in Stata 14.0 (StataCorp LP, College Station, TX) to account for the ECLS-B survey design elements of stratification, clustering, and weighting.

Results

Table 1 displays the characteristics of our analytic sample. Among the 7,950 preschool and kindergarten children in the analytic sample, 750 (6.6%) preschool children and 600 (7.5%) kindergarten children were told by their physicians of a DD diagnosis. Of those preschool children with a DD diagnosis, 500 (66.5%) were receiving developmental services, while 450 (69.1%) kindergarten children with a diagnosis of DD were receiving developmental services.

Multiple child characteristics were associated with receiving a DD diagnosis by preschool (Table 2). Children scoring in the bottom decile on standardized developmental assessment at any time prior to preschool were more likely to be diagnosed. A child who scored below the bottom decile on both the 9-month and 2-year assessments had the highest odds of being diagnosed, with an aOR of 9.53 (95% CI 6.46–14.06). Male children were also more likely to be diagnosed with DD (aOR 2.27, 95% CI 1.83– 2.81). Black children had the lowest regression coefficient of other racial/ethnic groups to be diagnosed with DD (aOR 0.42, 95% CI 0.29–0.61). Asian children were also less likely to be diagnosed (aOR 0.56, 95% CI 0.33–0.97), as were those whose primary language was not English (aOR 0.54, 95% CI 0.32–0.93) and those who lacked health insurance at 2-years old (aOR 0.43, 95% CI 0.22–0.83). Conversely, children attending center-based child care during preschool were more likely to obtain a diagnosis than those who did not attend (aOR 1.52, 95% CI 1.17 – 1.97).

Analyses examining child characteristics associated with receipt of developmental services by preschool amongst those with a diagnosis of DD revealed that race/ethnicity, developmental status, participation in center-based child care were significantly associated with receiving services. Black and Latinx children had decreased odds of receiving services by preschool (Table 2) (aOR 0.31, 95% CI 0.13 – 0.71 and aOR 0.35, 95% CI 0.15 – 0.86, respectively). Children scoring in the bottom decile on both the 9-month and 2-year assessments or those with downward trending developmental trajectory (scoring in the lowest decile at 24-months) and children attending center-based child care during preschool were more likely to receive developmental services (aOR 2.26, 95% CI 1.19 – 4.30).

Similar characteristics were associated with the likelihood of receiving a diagnosis by kindergarten to those associated with receiving a diagnosis in preschool (Table 3). Black and Asian children had decreased odds of being diagnosed (aOR 0.49, 95% CI 0.28 – 0.87 and aOR 0.53, 95% CI 0.28 – 0.98, respectively). Once again scoring in the lowest decile on either/both the 2-year and preschool developmental assessment was associated with increased odds of receiving a diagnosis. Scoring in the lowest decile on both the 2-year and the preschool assessments was associated with the highest odds of receiving a diagnosis, with an aOR 13.05 (95% CI 8.18 – 20.82). Children with a non-English primary language also had lower odds of receiving a diagnosis (aOR 0.47, 95% CI 0.27 – 0.84). Lastly, children without insurance during the kindergarten wave were less likely to be diagnosed (aOR 0.35, 95% CI 0.13 – 0.95). Characteristics associated with receiving developmental support services by kindergarten included race, economic status and parental education. Black children with a diagnosis had lower odds of receiving services (aOR 0.29, 95% CI 0.11–0.78), as were children living in homes with income 100% - below 130% of the federal poverty limit (aOR 0.27, 95% CI 0.09 - .85) when compared to children living in homes with income at or above 185% of the federal poverty limit (Table 3).

Discussion

In this nationally representative cohort of children, we found that a child's race/ethnicity, sex, primary-language spoken at home, insurance status, child care attendance and objectively measured developmental trajectory were all associated with parents reporting having being told by a doctor that their child have a DD diagnosis. Children scoring in the bottom decile of a validated developmental assessment (BSF-R) at either the preschool and/or kindergarten wave were more likely to have parents who reported their child had a DD diagnosis and more likely to receive EI services. Notably, parents of children who were racial/ethnic minorities and those who lived in non-English primary language households were less likely to report being told by a doctor of a DD diagnosis despite taking into account multiple patient and healthcare system factors on multivariable logistic regression.

The persistence of decreased odds of receiving a DD diagnosis even after controlling for access to well child care visits, socioeconomic status, child's sex, geographical residential area, insurance status, child care attendance, and scores on formal developmental assessments over time, suggest that lower likelihood of receiving a DD diagnosis among racial/ethnic and non-English speaking children are not explained by differences in the underlying prevalence of DD nor are they explained by the multiple patient and health care system variables we accounted for.

There are multiple potential sources of this disparity. There are patient factors we were unable to account for including parental understanding of normal development. Parents of minority, non-English primary language children may have a different understanding of normal pediatric development and developmental disorders that may lead to different help-seeking behavior.^[16 17] There are healthcare system factors we were unable to account for, notably access to validated developmental screening, provider availability or quality of care. Ethnic minority children and children in a non-English primary language home have been shown to have poorer primary care quality, less access to family-centered care

and receive poorer anticipatory guidance.^[18–20] These children also have decreased access to formal developmental assessment by being less able to see developmental behavioral specialists and less likely to receive a formal developmental assessment by EI, though some of these differences may be driven, in part, by decreased EI referral rates by primary care providers.^[21–24]

Physician and clinical encounter factors were also largely unexplored. Ethnic minority children and children in a non-English primary language home are more likely to have ineffective physician interactions due to difficulties in communication.^[25] Physicians may also be under the influence of implicit bias which may impact the encounter by contributing to difficulties in communication and by impacting the medical decision making process.^[26–27] In our specific study, our outcome variable was defined as “being told by a doctor” of a DD diagnosis. It is possible some of our disparities described are a result of physicians inadequately explaining a diagnosis. Both families and physicians may also lack knowledge of the EI referral process, which has been recognized to be a barrier to EI referrals and follow-up.^[28–29] Decreased use of developmental screening and overreliance on the generally less sensitive practice of developmental surveillance may also contribute.

Whether the factors contributing to the observed disparities are occurring inside or outside of the pediatric primary care clinic, pediatric primary care providers manage the culmination of potentially inadequate care and bear a large responsibility for identifying DD, communicating that diagnosis, and connecting a child with developmental services. Hence, it is critical to that pediatricians have the resources necessary to delivery care in a way that advances health equity.

Potential interventions to reduce the disparities observed in this study include integrating developmental and primary care services with the use of developmental specialist, parent coaches or developmental programs focused around strengthening the parent-child relationship via videotaping parental-patient interactions.^[30–32] These programs work to both educate parents and facilitate communication between parents and the pediatric team. Improving reimbursement rates for developmental screening can serve to increase their use. Building an infrastructure within the pediatric clinic, with case managers and social workers to improve screening completion and follow up of DD referrals. Physicians need training in cross-cultural communication and strategies to mitigate implicit bias. Finally, we must recognize the role of systemic racism in contributing to and perpetuating these disparities.^[33] As child health providers, we should advocate for policy changes that can improve child health equity, including, advocating for improved quality of pediatric primary care, combatting childhood poverty, increased rates of reimbursement for developmental screening, improved quality and access to public preschool and child care, increased administrative workers dedicated to assuring equal utilization of EI services and improving cultural competency and cross cultural communication training.

This present study has several limitations. We used the ECLS-B, and while it is a nationally representative cohort, we were limited by the available variables. Diagnosis was determined by parental report, which may under-estimate the true rate of diagnosis for DD. We also recognize that our outcome variable is dependent entirely on parental report and it is largely

reliant on parental recall and it is possible differences in recall may be contributing to disparities described; however, studies demonstrate parental recall of medical diagnosis correlate well with pediatricians' records, even for specific DD diagnoses and even while accounting for parental education.^[34 35] Additionally, data collection concluded in 2007, and the prevalence of DD has increased in recent years, which may impact the generalizability of our findings to the current era. However, we believe that many of the barriers and facilitators to diagnosis and management of DD are unlikely to have significantly. Despite these limitations we feel this study has important implications for pediatricians and child health advocates.

Conclusion

The study is the first to demonstrate racial and ethnic disparities in parental reports' of DD diagnoses, accounting for children's developmental status. Specifically, Black and Asian children, as well as children from non-English speaking households were less likely to receive a DD diagnosis and/or receive services for DD. This finding points to a critical need to develop and test interventions to reduce these disparities, including those delivered in clinical settings. Primary care providers have the potential to play a critical role in developing and implementing interventions to reduce disparities in access to developmental support services, as they are often the only professional with developmental training who regularly see children and families prior to starting school. As both direct providers and child health advocates, pediatricians are well poised to ensure that all children receive regular developmental screening, which supports timely diagnosis of delays, and the necessary care coordination to access services to ultimately maximize their developmental potential and reduce health disparities starting from a young age.

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Table 1:

Characteristics of sample population (weighted sample)

N = 7,950	Percentage (N)			
Race				
White	53.8 (3,500)			
Black	13.8 (1,250)			
Hispanic	25.2 (1,550)			
Asian	2.6 (750)			
Other	0.7 (250)			
Multiracial	3.9 (650)			
Annual Household Income				
185% of FPL	53.7 (4,300)			
130% - below 185% of FPL	12.6 (1,000)			
100% - below 130% of FPL	9.9 (750)			
< 100% of FPL	23.8 (1,900)			
Highest Parental Education				
Bachelor's	31.5 (2,850)			
Some college	25.9 (2,000)			
High school diploma/vocational	29.7 (2,150)			
< High school diploma	12.9 (950)			
Child Sex				
Female	48.8 (3,900)			
Male	51.2 (4,050)			
Urbanicity				
Rural	15.2 (1,300)			
Urban	84.9 (6,700)			
Primary Language Spoken at Home				
English	81.0 (6,400)			
Non-English	19.0 (1,550)			
Health Insurance	9-months	2-years	Preschool	Kinder
Yes	95.9 (7,700)	95.7 (7,650)	95.2 (7,600)	95.6 (5,900)
No	4.1 (250)	4.3 (300)	4.8 (350)	4.4 (250)
Well-child Visit in the past year (2 years old)				
2	88.9 (7,050)			
<2	11.1 (850)			
Well-child Visit in the past year (Preschool)				
1	96.3 (7,650)			
0	3.7 (250)			
Well-child Visit in the past year (Kindergarten)				
1	95.8 (5,850)			

N = 7,950	Percentage (N)		
0	4.2 (250)		
Center-based Child Care Attendance	9-months	2-years	Preschool
Yes	9.1 (700)	17.1 (1,350)	54.6 (4,500)
No	90.9 (7,250)	82.9 (6,650)	45.4 (3,450)
Developmental Trajectory (Preschool models)			
>10 th percentile 9-month BSF-R mental score and >10 th percentile 2-year BSF-R mental score	81.8 (6,000)		
<=10 th percentile 9-month BSF-R mental score and >10 th percentile 2-year BSF-R mental score	8.3 (900)		
>10 th percentile 9-month BSF-R mental score and <=10 th percentile 2-year BSF-R mental score	8.2 (750)		
<=10 th percentile 9-month BSF-R mental score and <=10 th percentile 2-year BSF-R mental score	1.8 (300)		
Developmental Trajectory (Kindergarten models)			
>10 th percentile 2-year BSF-R mental score and >10 th percentile for both preschool academic scores	78.1 (5,750)		
<=10 th percentile 2-year BSF-R mental score and >10 th percentile for both preschool academic scores	5.5 (600)		
>10 th percentile 2-year BSF-R mental score and <=10 th percentile at least one preschool academic score	13.0 (900)		
<=10 th percentile 2-year BSF-R mental score and <=10 th percentile at least one preschool academic score	3.4 (350)		
Diagnosis (by Preschool)			
No	93.4 (7,250)		
Yes	6.6 (750)		
Diagnosis (by Kindergarten entry)			
No	92.5 (5,500)		
Yes	7.5 (600)		
Services (by Preschool)			
No	33.5 (250)		
Yes	66.5 (500)		
Services (by Kindergarten entry)			
No	30.9 (200)		
Yes	69.1 (450)		

Unweighted sample sizes are rounded to the nearest 50, as required by the National Center for Education Statistics. We used a kindergarten entry wave sampling weight for the kindergarten entry variables. For the other variables, we used a preschool wave sampling weight. Receipt of services by preschool and receipt of services by kindergarten entry were restricted to children who had a diagnosis of developmental delay by preschool and kindergarten entry, respectively.

Table 2:

Diagnosis and service for preschool

	Preschool Diagnosis			Preschool Services		
	Odds ratio	p-value	95% CI	Odds ratio	p-value	95% CI
Race						
White	Reference			Reference		
Black	0.42	<0.001	0.29–0.61	0.31	0.01	0.13 – 0.71
Hispanic	0.84	0.47	0.53– 1.34	0.35	0.02	0.15 – 0.86
Asian	0.56	0.04	0.33– 0.97	0.37	0.11	0.11 – 1.26
Other	0.99	0.98	0.50– 1.97	0.61	0.46	0.16 – 2.29
Multiracial	0.52	0.03	0.30– 0.92	0.79	0.69	0.25 – 2.49
Annual household income						
At or above 185% of the poverty level	Reference			Reference		
below 100% poverty	1.41	0.07	0.97– 2.07	0.65	0.23	0.33 – 1.31
100% - below 130% poverty	0.96	0.86	0.59 – 1.54	0.43	0.17	0.13 – 1.43
130% - below 185% poverty	1.08	0.72	0.69– 1.70	0.56	0.22	0.22 – 1.42
Highest parental education						
Bachelor's	Reference			Reference		
Some college	0.95	0.79	0.63– 1.43	1.06	0.87	0.56 – 2.00
HS diploma	0.79	0.28	0.51– 1.22	1.87	0.09	0.91 – 3.82
< HS diploma	0.79	0.40	0.46– 1.36	1.79	0.25	0.66 – 4.88
Child Sex						
Female	Reference			Reference		
Male	2.27	<0.001	1.83– 2.81	1.39	0.29	0.75 – 2.59
Urbanicity						
Rural	Reference			Reference		
Urban	0.89	0.55	0.62– 1.30	1.39	0.42	0.62 – 3.12
Primary Language spoken at home						
English	Reference			Reference		
Non-English language	0.54	0.03	0.32– 0.93	0.77	0.55	0.33 – 1.81
Insurance status: 9 months, 2 years, preschool						
Yes	Reference			Reference		
9 months: No insurance	1.16	0.75	0.47– 2.87	0.34	0.18	0.07– 1.64
24 months: No insurance	0.43	0.01	0.22– 0.83	0.47	0.38	0.09 – 2.55
Preschool: No insurance	0.90	0.77	0.45– 1.81	0.90	0.89	0.20 – 4.10
Well child visits: 9 months – 2 years						
2 Well child visits from 9 months to 2 years	Reference			Reference		
< 2 Well child visits from 9 months to 2 years	1.19	0.38	0.81– 1.74	0.93	0.87	0.38 – 2.27
Well child visits: 2 years to preschool						
1 Well child visits 2 years to preschool	Reference			Reference		
0 Well child visits 2 years to preschool	0.67	0.31	0.31– 1.47	0.36	0.30	0.05 – 2.54

	Preschool Diagnosis			Preschool Services		
	Odds ratio	p-value	95% CI	Odds ratio	p-value	95% CI
Child is in center-based child care						
No	Reference			Reference		
9 months: yes	0.97	0.88	0.61 – 1.54	1.12	0.83	0.39 – 3.24
2 year: yes	1.33	0.09	0.95 – 1.86	1.17	0.61	0.64 – 2.12
Preschool: yes	1.52	0.002	1.17 – 1.97	2.26	0.01	1.19 – 4.30
Developmental trajectory: 9-month BSF-R mental score, 2-year BSF-R mental score						
>10 th % 9-month BSF-R score, >10 th % 2-year BSF-R score	Reference			Reference		
<=10 th % 9-month BSF-R score, >10 th % 2-year BSF-R score	2.39	<0.001	1.61– 3.54	0.94	0.85	0.50 – 1.77
>10 th % 9-month BSF-R score, <=10 th % 2-year BSF-R score	7.16	<0.001	5.13– 10.01	2.84	<0.001	1.63 – 4.94
<=10 th % 9-month BSF-R score, <=10 th % 2-year BSF-R score	9.53	<0.001	6.46– 14.06	3.25	0.04	1.08 – 9.71

We used a preschool wave sampling weight for the preschool models.

Table 3

Diagnosis and service for kindergarten entry

	Kindergarten Diagnosis			Kindergarten Services		
	Odds ratio	p-value	95% CI	Odds ratio	p-value	95% CI
Race						
White	Reference			Reference		
Black	0.49	0.02	0.28 – 0.87	0.29	0.02	0.11 – 0.78
Hispanic	0.80	0.40	0.47 – 1.35	0.45	0.12	0.16 – 1.23
Asian	0.53	0.04	0.28 – 0.98	0.39	0.19	0.09 – 1.61
Other	0.94	0.89	0.43 – 2.09	1.19	0.81	0.29 – 4.85
Multiracial	0.58	0.18	0.26 – 1.28	0.58	0.51	0.11 – 3.01
Annual household income						
At or above 185% of the poverty level	Reference			Reference		
below 100% poverty	1.29	0.33	0.77 – 2.18	0.81	0.62	0.35 – 1.87
100% - below 130% poverty	1.01	0.98	0.53 – 1.91	0.27	0.03	0.09 – 0.85
130% - below 185% poverty	1.20	0.43	0.79 – 1.91	0.73	0.58	0.24 – 2.23
Highest parental education						
Bachelor's	Reference			Reference		
Some college	0.67	0.11	0.40 – 1.10	1.06	0.88	0.51 – 2.19
HS diploma	0.79	0.40	0.46 – 1.36	3.18	0.02	1.23 – 8.27
< HS diploma	0.64	0.20	0.32 – 1.28	1.43	0.56	0.41 – 4.96
Child sex						
Female	Reference			Reference		
Male	2.28	<0.001	1.57 – 3.31	1.12	0.76	0.55 – 2.29
Urbanicity						
Rural	Reference			Reference		
Urban	1.06	0.81	0.66 – 1.71	1.23	0.60	0.56 – 2.71
Primary Language spoken at home						
English	Reference			Reference		
Non-english language	0.47	0.01	0.27 – 0.84	1.23	0.72	0.39 – 3.81
Insurance status: 9 months, 2 years, preschool, kindergarten						
Yes	Reference			Reference		
9 months: No insurance	0.92	0.89	0.29 – 2.91	2.69	0.27	0.46 – 15.78
24 months: No insurance	0.61	0.33	0.22 – 1.68	0.13	0.14	0.01 – 1.90
Preschool: No insurance	0.63	0.42	0.20 – 1.95	0.67	0.70	0.08 – 5.47
Kindergarten: No insurance	0.35	0.04	0.13 – 0.95	0.70	0.74	0.08 – 5.92
Well child visits: Number of visits, 9 months – 2 years						
2 Well child visits	Reference			Reference		
< 2 Well child visits	0.96	0.86	0.59 – 1.56	0.52	0.28	0.16 – 1.73
Well child visits: Number of visits, 2 years to preschool						
1 Well child visits	Reference			Reference		

	Kindergarten Diagnosis			Kindergarten Services		
	Odds ratio	p-value	95% CI	Odds ratio	p-value	95% CI
0 Well child visits	0.91	0.84	0.34 – 2.43	0.68	0.77	0.05 – 9.22
Well child visits: Number of visits, preschool to kinder						
1 Well child visits	Reference			Reference		
< 0 Well child visits	0.44	0.11	0.16 – 1.21	0.11	0.11	0.01 – 1.71
Child is in center-based child care						
No	Reference			Reference		
9 months: yes	0.61	0.10	0.34 – 1.11	1.13	0.85	0.30 – 4.20
2 year: yes	1.37	0.17	0.88 – 2.13	1.95	0.07	0.94 – 4.02
Preschool: yes	1.71	0.002	1.22 – 2.40	2.12	0.06	0.98 – 4.62
Developmental trajectory: 2-year BSF-R mental scale score, Preschool early reading and math IRT scale scores						
>10 th % 2-year BSF-R score, >10 th % Preschool score	Reference			Reference		
<=10 th % 2-year BSF-R score, >10 th % Preschool score	6.52	<0.001	4.32 – 9.84	2.37	0.12	0.79 – 7.07
>10 th % 2-year BSF-R score, <=10 th % Preschool score	2.83	<0.001	1.86 – 4.32	0.74	0.51	0.30 – 1.84
<=10 th % 2-year BSF-R score, <=10 th % Preschool score	13.05	<0.001	8.18 – 20.82	2.47	0.06	0.95 – 6.42

We used a kindergarten entry wave sampling weight for the kindergarten entry models.