# Do Minority Children have Equitable Access to Early Intervention and Early Childhood Special Education Services?

## Abstract

We used a large preschool-aged sample of 48-month-olds (*N*=7,689) participating in the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B) to investigate whether and to what degree minority children had equitable access to early intervention and/or early childhood special education (EC/ECSE) services. Logistic regression analyses indicated that, both prior to and after extensive statistical control of factors related to children's cognitive and behavioral functioning (i.e., socio-demographic, gestational, and birth characteristics, as well as early academic skills proficiency and frequency of externalizing and internalizing behavior problems), preschool-aged children who are Black, Hispanic, or Asian are less likely to be provided EI/ECSE services than otherwise identical children who are white (OR range=.21-.41). Low-income children are also less likely to receive these services (OR range=.44-.63). These groups of children are less likely to receive EI/ECSE services despite their greater likelihood of displaying very low levels of early academic skills proficiency.

# Do Minority Children have Equitable Access to Early Intervention and Early Childhood Special Education Services?

Federal legislation (i.e., the Individuals with Disabilities Education Act, or IDEA) provides funds for states to establish coordinated, multidisciplinary, and interagency systems for delivering early intervention and/or early childhood special education (EI/ECSE) to any eligible children. Eligible children are those displaying cognitive, behavioral, and/or physical delays or disabilities. Part C of IDEA helps make EI services available to children from birth to age 3 and their families (U.S. Department of Education, 2005). Part B (section 619) of IDEA helps provide children ages 3 to 5 with the ECSE services necessary to allow the children to receive a free and appropriate public education.

Substantial numbers of children currently receive EI/ECSE services. The U.S. Department of Education reports that 279,154 and 693,245 children received Part C and B services, respectively, in 2004 (U.S. Department of Education, 2006). Preschool-aged children receiving services under Part B now constitute 6% of population U.S. children aged 3 to 5. The number of children receiving EI/ECSE services is also rapidly increasing. Between 1995 and 2004, the total number of children served under IDEA Part C and B increased by 60% and 31%, respectively. The federal government allocates sizable appropriations to fund Part C and B. For example, in 2002, Congress appropriated $807 million to help ensure the delivery of EI/ECSE services (Council for Exceptional Children, 2003).

The receipt of EI/ECSE services should increase children's cognitive, behavioral, and/or physical capabilities by mitigating the effects of their delays or disabilities (Bateman & Linden, 2006). Providing these services prior to children's entry into kindergarten may also help reduce the need for school-based special education, which can be expensive, of limited effectiveness, and potentially stigmatizing (La Greca & Stone, 1990; Morgan, Frisco, Farkas, & Hibel, 2010; Valas, 2001). Empirical work repeatedly indicates that early interventions can increase at risk or disabled children's cognitive, behavioral, and physical capabilities (for a review, see Castro & Mastropieri, 1986). Martin, Ramey, and Ramey's (1990) randomized experiment indicated that 95% of at risk children provided with intensive intervention displayed normal levels of IQ at 3 years of age. In contrast, only 49% of children in the control group displayed these IQ levels. Jenkins, Dale, Mills, Cole, Pious, and Ronk's (2006) evaluation indicated that children with delays and disabilities who received high-quality EI/ECSE services as preschoolers displayed higher cognitive abilities and academic achievement, as well as lower rates of special education placement, by age 19 than peers who had not received these services.

## Do Minority Children have Equitable Access to EI/ECSE Services?

However, and despite both the increasing use and potential benefits of EI/ECSE services, there are theoretical and empirical reasons to believe that children of racial/ethnic minority heritage in the U.S. may have inequitable access to these services. Blanchett, Klingner, and Harry (2010) recently characterized the professional literature as "replete with documentation of individuals of color with developmental disabilities and their families' limited access to or unfamiliarity with available special education and human and community services" (p. 401). They theorized that these barriers result from poverty, racism, and a lack of culturally appropriate services. Garcia Coll et al. (1996) theorized that social stratification by race, ethnicity, and economic class results in racism and segregation, which in turn may inhibit the quality of young children's environments, and so negatively impact the development of their cognitive, social, and emotional competencies. (It is important to note that many minority and low-income families adopt practices that help counter these factors, and instead promote their children's competencies; e.g., De Feyter & Winsler; 2009). Despite the children's resulting greater risk of displaying cognitive or behavioral delays or disorders, the children's families should be expected to underutilize publically available services (e.g., health care) due to socio-economic, linguistic, and cultural barriers. For example, and because of the larger society's economic and discriminatory environments, minority families would be expected to avoid relying "on mainstream institutions to provide assistance and help to meet the differential developmental needs of family members" (p. 1906). Minority families would instead rely on the social support of extended families. Mickelson (2003) recently synthesized the extant social science on what she characterized as "racially correlated opportunities to learn" (p. 1060). These included lower resource allocation, community segregation, and reduced human, financial, and social capital. Mickelson concluded that the well-established racial/ethnic gaps in education result from a complex dynamic that cumulates over time. Mickelson theorized that racial disparities in educational opportunity should begin to manifest very early on, particularly as minority children transition to preschool or kindergarten. Rimm-Kaufman and Pianta's (2000) ecological and dynamic model posits that a family's relative success in accessing a school's or community's specialized services contributes to the child's transition to kindergarten, as well as the child's learning and behavior in school over time.

Bailey, Scarborough, and Hebbeler (2003) analyses of the National Early Intervention Longitudinal Study, a large, nationally representative sample of 3,338 children receiving EI services, provide some support for this theoretical account. Their results indicated that minority families reported finding it difficult to learn about the availability of EI services. Minority families also felt that professionals (whose clinical judgments play a critical role in the evaluation and eligibility process) were less likely to respect their values and cultural backgrounds, as well as more likely to ignore their opinions before making a diagnosis. Follow-up analyses indicated that minority families were also more likely to report negative experiences with EI service professionals and lower satisfaction with the quality of services their children eventually received (Bailey, Scarborough, Hebbeler, Spiker, & Malli, 2004).

## The Extant Work's Methodological and Substantive Limitations

Do minority children in the U.S. have equitable access to EI/ECSE services? To date, methodological limitations have made this question difficult to answer. The great majority of studies of minority children's receipt of services have used school-aged samples (Donovan & Cross, 2002). These studies have also failed to statistically control for confounding factors when investigating minority children's likelihood of receiving services. For instance, Waitoller et al.'s (2010) synthesis indicated that only 1 of the 42 the included studies (i.e., 2.4%) reported data on the children's socio-economic and -demographic, academic, and behavioral functioning. Most of the existing population datasets of children receiving EI/ECSE services (e.g., the National Early Intervention Longitudinal Study, the Pre-Elementary Educational Study) do not include "control" groups of who did not receive these services, necessarily constraining statistical control for confounding factors. Yet estimating any inequitable access that is attributable to children's race/ethnicity necessitates controlling for confounding factors (e.g., Delgado & Scott, 2006; Delgado, Vagi, & Scott, 2005; Donovan & Cross; Flores and the Committee on Pediatric Research, 2010; Kavale, 1988; Keiffer, 2008; Mann, McCartney, & Park, 2007). Failing to do so may "mask" inequitable access because minority children are more likely to be exposed to the health, environmental, nutritional, social, and economic factors that themselves increase the likelihood of disabilities or delays (e.g., Garcia Coll et al., 1996; Donovan & Cross; Hosp & Reschly, 2003; Farkas, 2003; MacMillan & Reschly, 1996; Mickelson, 203). For instance, Scarborough et al. (2004) reported that 50% of African American children receiving EI services lived in poverty or had been born with low birthweight. Poverty and low birthweight greatly elevate a child's risk of disability or developmental delay (Hogan & Park, 2000) As noted by Klinger, Blanchett, and Harry (2007), "being a person of color in and of itself does not cause developmental disabilities, but people of color experience social and economic disparities in the form of higher levels of unemployment or under-employment, decreased earnings, economic instability, and decreased distribution of income and wealth (p. 56)." Consequently, the failure to account for minority children's elevated risk of exposure to the health, environmental, social, and economic factors that themselves contribute to the incidence of disabilities or delays may have resulted in inaccurate estimates of minority children's likelihood of being identified as delayed or disabled, and thus of receiving services. Put another way, it has yet to be established whether and to what extent any observed disparities in minority children's access to EI/ECSE services may instead be attributable to factors other than these children's status as race/ethnicity minorities.

Methodological limitations also characterize those few investigations that have attempted to control for potential confounds. These studies have typically controlled for confounding factors using aggregated district- or state-level data (e.g., Artiles et al., 2005; Hosp & Reschley, 2004). For instance, Skiba et al. (2005) recently reported that poverty was a "weak and inconsistent predictor of disproportionality" (p. 141). Measurement error may have contributed to the finding, however, as the effects of poverty were estimated indirectly using district-level data on the percentage of children attending a school who were receiving free or reduced lunch, which itself is considered a flawed indicator of children's socio-economic status (Harwell & LeBeau, 2010). To our knowledge, no prior study has controlled for SES using more direct, family-level data. Doing so should better account for the strong confounding effects of SES. Additionally, prior investigations have not controlled for the child's gestational or birth characteristics (e.g., congenital anomalies), which should also constitute strong confounds. Researchers have repeatedly called for studies that control for confounding factors when estimating minority children's likelihood of receipt of specialized services (e.g., Donovan & Cross, 2002; Hosp & Reschly 2003; MacMillan & Reschly, 1996).

## Studies Using Extensive Statistical Control Report Minority Children Under-access Services

There is some indication that minority children in the U.S. may currently be under-served by EI/ECSE professionals. Findings from three recent studies that used extensive statistical control for confounding factors point to disparities in minority children's access to special education services. Hibel, Farkas, and Morgan (2010) analyzed a nationally representative and longitudinal sample of school-aged children. Their analyses initially indicated that some groups of minority children were over-identified as disabled. However, analyses that statistically accounted for children's gender, socioeconomic status (SES), as well as in their relative reading and mathematics achievement, instead indicated that minority children were systematically under-identified. For example, the initial analyses indicated that kindergarten children who were Black were 1.25 times more likely to receive special education services than same-age peers who were white. However, statistical control for likely confounds reversed the directionality of this estimate. Black children were instead .61 times *less* likely to receive special education services than white children. Foran's (2007) analyses of 4th, 8th, and 12th grade special education placement rates for the state of Rhode Island yielded this same pattern. Foran's analyses initially indicated that minority children were sometimes more likely to over-identified as disabled. Yet statistically controlling for gender, SES, and academic achievement substantially revered the directionality of these estimates. Instead, and for each of the three grade levels, minority children were repeatedly found to be less likely to receive special education services. Delgado and Scott (2006) used data from children's birth certificates to identify risk factors for a later referral for services in the state of Florida due to potential IDEA eligibility. Their results indicated that preschool children who were born premature, or with low birthweight, or were being raised by mothers with low education levels were more likely to be referred for special education services by age 4. Controlling for these factors, children who were Black or Asian were less likely to be referred for EI/ECSE children than White children. Collectively, these studies indicate that disparities in children's receipt of special education services may be attributable to their status as racial/ethnic minorities, with these children having less access to EI/ECSE services than children who are white.

However, and despite calls for such work (e.g., Farkas, 2003), no study has yet used a large and nationally representative sample of preschool-aged children to estimate whether minority children in the U.S. are being systematically under-served by EI/ECSE professionals, after extensive control for a wide range of socio-demographic, gestational, and birth characteristics, as well as variation in these children's academic and behavioral functioning. Such extensive statistical control should provide far more rigorously derived and generalizable estimates than those currently available. Finding that minority children have less equitable access to EI/ECSE services in the U.S. would have far-reaching policy implications, particularly given the well-established importance of intervening early to further children's cognitive, behavioral, and physical development.

## Study's Purpose

We used a large, nationally representative sample of 7,689 48-month olds to identify which groups of children in the U.S. were likely to receive EI/ECSE services. We hypothesized that racial/ethnic minority children would have inequitable access to EI/ECSE services. We therefore designed the study to investigate three inter-related questions. First, to what extent are minority children at greater risk for early numeracy or language delays? These analyses should help quantify minority children's relative "need" for EI/ECSE services. Second, are minority children experiencing less equitable access to EI/ECSE services generally? Because these analyses statistically controlled for a wide range of confounding factors, including socio-demographic, gestational, and birth characteristics, as well as variation in the children's academic and behavioral functioning, they should yield rigorously derived point estimates of the extent of any inequitable access that is itself attributable to the children's race/ethnicity. Third, are minority children under-diagnosed by professionals as having communication, attention, or learning disorders or delays? These analyses should function as a type of replication if they indicate that any inequitable access evident in the receipt of EI/ECSE services generally also is evident in reported diagnoses for specific delays or disabilities. Collectively, the study's analyses should provide the most rigorously derived and generalizable estimates yet available of the extent to any observed inequitable access to EC/ECSE in the U.S is attributable to children's race/ethnicity.

# Method

## Sample

We used data from an analytical sample of children participating in the ECLS-B. The ECLS-B is a nationally representative, longitudinal cohort study of children born in 2001. The ECLS-B is maintained by the National Center for Education Statistics (NCES), U.S. Department of Education. NCES selected the sample using birth certificate records. The ECLS-B sample includes oversamples of Asian and Pacific Islanders, Native Americans and Alaska Natives, low birthweight (1,500-2,500 gramsea) and very low birthweight (less than 1,500 grams) children, and twins. At approximately 9 months (i.e., 2001-2002), 24 months (i.e., 2003), and 48 months (i.e., 2005) after the child's birth, ECLS-B field staff administered a battery of cognitive, and behavioral, and physical measures. Field staff also interviewed the children's parents. Our analytical sub-sample includes those 7,689 singleton and non-singleton children with and without disabilities or delays who had complete data from the administration of the developmental measures when the study's analytical sample of children were approximately 48 months of age.

## Measures

Our analyses attempted to control for a wide range of potential confounds when estimating the extent to which access to EI/ECSE services was itself attributable to children's race/ethnicity or SES status. We controlled for three types of confounds. The first could be characterized as the child's or family's socio-demographic characteristics. For example, boys are two to three times more likely to be identified as learning disabled than girls, regardless of the identification method used (Katusic, Colligan, Barbaresi, Schaid, & Jacobsen, 2001). The family's SES, as well as the parents' marital status, also predicts the receipt of special education services (e.g., Hosp & Reschley, 2004; Mann et al., 2007). Mannerkoski et al. (2007) estimated that children raised by parents older than 40 were two to three times more likely to receive special education services than those raised by younger parents. The second category is the child's gestational or birth characteristics. For instance, low birthweight has been repeatedly found to elevate a child's risk for disability identification (e.g., Chaudhari, Otiv, Chitale, Pandit,

& Hoge, 2004; Litt, Taylor, Klein, & Hack, 2005). Mannerkoski et al. (2007) estimated that very low birthweight children were three to five times as likely as normal birthweight children to receive special education services. The third category is the child's relative proficiency in reading or mathematics, as well as the frequency of his or her problem behaviors (e.g., Mann et al., 2007; Merrell & Shinn, 1990). Hibel et al. (2009) reported that kindergarten children with greater proficiency in reading and mathematics were less likely to receive special education services by 5th grade (i.e., an odds ratio [OR] of .24). Thus, our analyses used data collected from measures of children's socio-demographic, gestational, and birth characteristics.

**Child's Status as Disabled or Delayed.** NCES field staff interviewed a child's parent about whether the child was receiving EI/ECSE services due to a disability or delay. Field staff were recruited from the same geographical area as interviewed parents. Field staff administered the parent interviews (as well as the receptive vocabulary and numeracy measures) in English or Spanish. Field staff began by stating that there are special services available to families with children who have special needs. Next, the parent was asked whether the child or family had received such special services, as indicated by the child's receipt of an Individualized Education Program (IEP) or the family's participation in an Individual Family Services Plan (IFSP). Federal legislation requires the IEP or IFSP, which is a written and signed document detailing the specific EI/ECSE services to be provided. Specifically, field staff asked the following question:

> When a child with a disability or developmental delay receives special education and/or related services sponsored through your local education agency—that is the school system—these services are initiated after a diagnosis of condition, or evaluation of the child, and development of an IEP or an IFSP, which is discussed with and signed by the

parent. Is (child) receiving special education services related to either an IEP or an IFSP? We coded the parent's response of "no" as 0 and "yes" as 1. We identified 441 children whose parents indicated that they had received EI/ECSE services. These children also had complete sampling weight data (which was necessary for our analyses given our use of data obtained from the children's birth certificate), as well as complete data on their socio-demographic, gestational, and birth characteristics and relative proficiency in receptive vocabulary and numeracy. Parents also reported the condition for which the child was receiving special services (e.g. ADHD, autism, mental retardation).

We sought to obtain rigorously derived point estimates of a child's receipt of EI/ECSE services generally. This is consistent with prior studies (e.g., Delgado & Scott, Hibel et al., 2010 Palfrey et al., 1987), which has dichotomized children as either receiving or not receiving services regardless of their particular diagnosis. However, we also extended this prior work by examining whether any observed disparities evident in service delivery generally are also evident for two more specific conditions (i.e., communication problems, attention or learning problems). These two more specific conditions constituted the most common delay or disability conditions as reported by parents in the ECLS-B dataset.

Our analyses rely on parent reports of their child's receipt of EI/ECSE services. Prior work repeatedly indicates that parents can reliably identify whether their children display cognitive or behavioral delays, and so are likely to be identified as disabled (Chen, Lin, Wen, & Wu, 2007; Glascoe & Dworkin, 1995; Johnson et al., 2004; Johnson, Wolke, Marlow, & the Preterm Infant Parenting Study Group, 2008). For instance, Glascoe (1999) reported sensitivity and specificity rates of 74-79% and 70%-80%, respectively, between parent interviews and results from standardized test batteries. Chen, Lee, Yeh, Lai, and Chen (2004) recently reported a sensitivity rate between parent's report and a professional's diagnosis (that itself resulted from the child's performance on independently administered speech, motor, behavioral, cognitive, or global measures) of developmental delay to be 77%-89%. Parents are an appropriate source of disability identification, particularly for children who have not yet entered school. Collectively, this research indicates that parent interviews "are as accurate as high quality screening tests" (Glascoe, p. 24) in identifying disabilities or delays in young children.

Multiple features of this study's data also indicate that parents reliably reported their child's receipt of services. The parent-reported prevalence rate was 5%. This rate closely approximates the 6% disability or delay prevalence rate for young children receiving ECSE services in the U.S. (U.S. Department of Education, 2006). Second, follow up analyses indicated that children reported by their parents to be receiving EI/ECSE services were more likely to display delays in both early numeracy and receptive vocabulary. Specifically (and as indicated in Table 3 below), the odds that a child with a parent-reported IEP or IFSP performed in the bottom 10% of the distribution of scores on the individually administered ECLS-B numeracy and receptive vocabulary measures were 1.93 and 3.41 times, respectively, higher than the likelihood that a child without a parent-reported IEP or IFSP performed in the bottom 10%. These highly statistically significant estimates were derived after extensive control for potential confounds. Thus, these estimates provide another indication that parents accurately identified their children as receiving EI/ECSE services. This is because children whose parents identified them as receiving EI/ECSE services were more likely to display numeracy or language delays on measures individually- and independently-administered by NCES field staff. Most of those children identified by their parents as receiving EI/ECSE services were also reported to have communication problems. This is consistent with prior work indicating that the majority of preschool-aged children receive services due to communication disorder or delay (e.g., Hebbeler et al., 2007). NCES also conducted extensive analyses of non-response bias by the interviewed parents. These analyses evaluated in part whether parents of various racial/ethnic groups were more likely to systematically not respond to any particular items (e.g., their child's disability status) during the interviews. These analyses yielded no evidence of non-response bias (e.g., Chernoff, Flanagan, McPhee, & Park, 2007, pp. 22-23). Attributing any observed disparities to parent mistaken recall is unlikely, as disability identification "is so salient to families that parent recall is likely to be accurate." (Palfrey et al., 1987, p. 653). Mistaken recall is also unlikely given that EI/ECSE services are not provided until an eligibility evaluation has been conducted—which itself is a multi-stage process involving multiple professionals commonly conducting evaluations in the child's home—and resulting oral and written documentation of the results of the evaluation, as well as of the parent-agreed upon and -signed IEP or IFSP.

We also conducted follow up analyses of parent responses to two additional sets of questions about the child's disability status. The first asked whether the child had been "evaluated by a professional in response to (his/her) ability to communicate" and, if so, whether the parent had obtained "a diagnosis of a problem from a professional." The second set of questions asked whether the child had "been evaluated by a professional in response to (his/her) ability to pay attention or learn" and, if so, whether the parent had obtained "a diagnosis of a problem from a professional." Parents were asked these questions regardless of whether they had indicated that the child was receiving EI/ECSE services.

**Child's Gender, Age.** The surveyed parent identified the child's gender. We coded females as 0, as the reference category, and males as 1. The ECLS-B study design specified that data be collected from children at approximately 48 months of age. However, and due to the large number of children and families surveyed, there was some variation in children's ages around the 48 months period. We therefore included age in months to statistically control for this variation.

**Child's Race/Ethnicity.** We used the race/ethnicity of the child's mother to identify the child's race/ethnicity. This information was obtained from the child's birth certificate in accordance with National Center for Health Statistics procedures. We used Non-Hispanic White as the reference category. The other categories were as follows: (a) African American; (b) Hispanic; (c) Asian (e.g., Korean, Chinese, Indian, Japanese); or (d) "Other" race or ethnicity.

**Family's SES.** We estimated the effects of a family socio-economic status (SES) using an NCES-constructed measure. Field staff collected the following information from the child's parents: (a) father/male guardian's education; (b) mother/female guardian's education; (c) father/male guardian's occupation; (d) mother/female guardian's occupation; and (e) household income. A composite SES measure was then created by transforming each of these variables into a Z-score, and averaging these. The five-category SES variable used here consists of the quintile of the distribution for the value of the composite SES of each family. The first quintile represents the lowest category, and the fifth quintile represents the highest category. In cases where only one parent was interviewed, not all the survey information was obtained. In these cases, the family's SES was computed by averaging the obtained information. A small percentage of data for each SES component was missing because not all respondents answered every question. This occurred most frequently for household income. Of these data, 3.39% were missing. NCES imputed the missing data using a hot deck methodology. In our logistic regression modeling, we coded four dummy variables to represent the family's SES. We used the fifth quintile as the reference category. Because NCES directly surveyed a child's family about their SES, our analyses should provide more accurate estimates of the relation between SES and children's identification as delayed or disabled than those reported in prior studies. Prior work estimated the effects of SES using indirect school- or district-level surveys of the percentage of children attending the school receiving free or reduced lunch (e.g., Hosp & Reschly, 2004; Skiba et al., 2005), which itself has been identified as a flawed indicator of children's SES (Harwell & LeBeau, 2010).

**Mother's Age and Marital Status.** We coded as a dichotomous variable the mother's age at the time of the child's birth. Those mothers aged 35 years or older at the time of the child's birth were coded as 1; mothers younger than 35 were used as the reference category. We also coded for the mother's marital status at the child's birth. We used married mothers as the reference category. We coded unmarried mothers as 1.

**Child's Gestational and Birth Characteristics.** We constructed a count of the medical risk factors present during the mother's pregnancy. We used the following information, as recorded on the child's birth certificate: (a) incompetent cervix (b) acute or chronic lung disease; (c) chronic hypertension; (d) pregnancy-induced hypertension; (e) eclampsia, diabetes; (f) hemoglobinopathy; (g) cardiac disease; (h) anemia; (i) renal disease; (j) genital herpes; (k) oligohydramnios; (l) uterine bleeding; (m) Rh sensitization; (n) previous birth weighing 4000+ grams; (p) or previous preterm birth.

We also used a count of maternal behavioral risk factors occurring during pregnancy. This information was obtained from the child's birth certificate. Behavioral risks include any maternal use of alcohol and/or tobacco during pregnancy. We also computed a count of the following obstetric procedures occurring during pregnancy, labor and/or delivery as recorded on the birth certificate: (a) induction of labor; (b) stimulation of labor; (c) tocolysis; (d) amniocentesis, and (e) cesarean section. We used a count of the number of labor complications experienced as recorded on the birth certificate from the following list: (a) abruptio placenta; (b) anesthetic complications; (c) dysfunctional labor; (d) breech/malpresentation; (e) cephalopelvic disproportion; (f) cord prolapse, (g) fetal distress; (h) excessive bleeding; (i) fever of >100 degrees; (j) moderate/heavy meconium; (k) precipitous labor (<3 hours); (l) prolonged labor (>20 hours); (m) placenta previa; or (n) seizures during labor.

We used two indicators of preterm delivery. The first indicated a very preterm birth. This was equal to 1 for births occurring at ≤32 weeks of completed gestation. The second indicated a moderately preterm birth. This was equal to 1 for births occurring between 33 and 36 weeks of completed gestation. We also used two indicators for the child's birthweight. Very low birthweight was a dichotomous variable equal to 1 for births weighing ≤1500 grams. Moderately low birthweight was a dichotomous variable equal to 1 for births weighing 1,501-2,500 grams. We used a dummy code of 1 for any congenital anomaly that was reported to be present at birth.

**Child's Early Academic Skills Proficiency.** We used two indicators of a child's early academic skills proficiency. These measures evaluated children's receptive language and numeracy skills. The early acquisition of receptive vocabulary and numeracy skills (e.g., number identification, counting) are theorized to be (e.g., Baroody, Lai, & Mix, 2006; Gersten, Jordan, & Flojo, 2005; Scarborough, 1990) and empirically established (e.g., Aunola, Leskinen, Lerkkanen, & Nurmi, 2004; Bodovski & Farkas, 2007; Wise, Sevcik, Morris, Lovett, & Wolf, 2007) as strongly related to disabled or delayed children's subsequent reading or mathematics achievement. Items used in the measures were adopted from other standardized measures, such as the Peabody Picture Vocabulary Test-III and the Test of Early Mathematics Ability-3. Items from the Family and Child Experiences Study (FACES) and the Head Start Impact Study were also used. The majority of items had been previously used in measures administered to children participating in the Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K). The ECLS-K is another large-scale, longitudinal, and nationally representative dataset maintained by the U. S. Department of Education. The ECLS-K measures (e.g., the Reading Test, the Mathematics Test) also display very strong psychometric properties. Fall of kindergarten theta reliabilities (the appropriate estimate for internal inconsistency) for the Reading Test and Mathematics Test were .93 and .92, respectively (NCES, 2005).

The ECLS-B measures were constructed using item response theory (IRT). For each measure, children were administered one set of items (i.e., a routing test), followed by a second set of items whose difficulty depended on the children's initial responses. That is, the measures used an adaptive two-stage design in which a single, common set of items was administered to all children, with additional items administered only to children who performed very poorly or very well on these common items. The measures were field-tested. Field staff administered each measure individually, using an untimed format. The receptive language measure evaluated children's receptive language skills and vocabulary. Children initially responded to 15 items. Based on the accuracy of their responses, the children were administered additional items or routed out of the English version. Thus, a portion of the measure was also used to assess children's English-language proficiency. Children were routed to the Spanish version if their parent had indicated that the children had knowledge of Spanish. The numeracy measure included 46 items. Specifically, the measure evaluated preschool children's number sense (10 items), counting ability (14 items), knowledge of operations (8 items), understanding of geometry (10 items), and pattern understanding (4 items). The 48-month reliabilities of the IRT scores on the early reading and numeracy measures were .84 and .89, respectively (Najarian, Snow, Lennon, & Kinsey, 2010).

**Child's Frequency of Problem Behaviors.** We included measures of the frequency of the child's externalizing and internalizing problem behaviors as additional statistical controls. Problem behavior, like numeracy or language delays, should make children's receipt of EI/ECSE services more likely and so be accounted for (e.g., Hibel et al., 2010; Mann et al., 2007). NCES collected information about a child's behavior by using a modified version of the Preschool and Kindergarten Behavior Scales, 2nd ed. (PKBS-2; Merrell, 2003). Internal consistency estimates of the PKBS-2 range from .96 to .97 (Pro-Ed, 2007). NCES selected 16 items to administer to the ECLS-B sample. Some items were modified on the basis of expert review. NCES also included additional items, which were deigned to measure children's learning-related behaviors (e.g., attention, task persistence, organization) and friendship skills.

Field staff administered the behavior measure by asking a parent to consider the child's behavior in the last three months. For those items that ask about how the parent's child behaves with other children, field staff asked the parent to think about their child's behavior during interaction with children who are no more than 2 years older or younger than his or her child. Parents rated the frequency of the particular behavior under these circumstances. Specifically, they reported whether each behavior had been observed very often, often, sometimes, rarely, or never during these interactions occurring within the past three months.

We used these survey data to identify two types of problem behavior. These were externalizing and internalizing problem behavior. These constitute the two major types of childhood psychopathology (Krueger, Caspi, Moffit, & Silva, 1998). We used a count variable to measure the frequency of the child's externalizing problem behaviors. Specifically, we summed a parent’s responses on 8 particular behaviors. These were (a) displays anger; (b) displays aggressiveness; (c) is impulsive; (d) is overly active; (e) has a bad temper; (f) has trouble concentrating; (g) annoys other children; and (h) destroys other children’s things. We used a count variable to measure the frequency of the child’s internalizing problem behaviors. Specifically, we summed a parent’s responses on two particular behaviors. These were (a) child is unhappy and (b) child worries. A higher score indicated that the particular type of behavior occurred more frequently. Item-to-total correlations ranged from .60-.70 and .70-.85 for the externalizing and internalizing problem behavior scales, respectively.

## Analyses

We used logistic regression to conduct our analyses. Logistic regression evaluates relations between dichotomous criterion variables (i.e., disabled vs. not disabled) and categorical (e.g., male vs. female, very low vs. moderately low vs. not low birthweight) and continuous (e.g., a child’s score of a measure of early numeracy skill) predictor variables (Peng, Lee, & Ingersoll, 2002). Logistic regression does not assume normally distributed variables or homoscadasticity (Tabachnick & Fidell, 2007).

Our analyses estimated three sets logistic regression models. The first set identified factors predictive of or associated with very low levels of proficiency in receptive vocabulary and, separately, numeracy. The purpose of this first set of analyses was to estimate whether and to what extent children of racial/ethnic minority heritage might be more likely to display low levels of such proficiency, and so might be might be characterized as potentially in need of EI/ECSE services due to numeracy or language delays. These analyses should better quantify the magnitude of the “gap” between minority children’s observed need and receipt of EI/ECSE services. Establishing whether and to what extent minority children are more likely to display numeracy or language delays is a key analytical first step when investigating whether these children are under-represented in their receipt of EI/ECSE services. It is possible that minority children—particularly prior to school entry—are *less* likely to display numeracy and language delays, which in turn would better justify any observed under-use of EI/ECSE services (e.g., Garcia Coll et al., 1996).

Model 1 included only the child's socio-demographic characteristics (i.e., gender, age, and race/ethnicity). Model 2 added the family's socio-demographic characteristics (i.e., the family's SES, the mother's age at the child's birth, the mother's marital status when the child was born) and the child's gestational and birth characteristics (e.g., whether the child's mother drank or smoked during the pregnancy, whether the child was born premature or with low birthweight, whether there were congenital anomalies). Model 3 added the child's frequency of externalizing and internalizing problem behaviors. Model 4 added whether the child's parents had reported the child to be receiving EI/ECSE services. These models increasingly controlled for potential confounds, thereby allowing us to report rigorously derived estimates of the degree to which 48-month-old minority children may be more likely to display very low levels of proficiency in receptive language or numeracy.

The second set of logistic regression models identified factors predictive of or associated with preschool children's receipt of EI/ECSE services. Model 1 included only the child's socio-demographic characteristics. Model 2 added the family's socio-demographic characteristics and the child's gestational and birth characteristics. Model 3 added the child's level of knowledge about receptive vocabulary and numeracy. Model 4 added the child's frequency of externalizing and internalizing problem behaviors. Estimation of this second set of models served two purposes. First, the estimated models allowed us to evaluate to what extent the child's race/ethnicity contributed to children's likelihood of receiving EI/ECSE services (i.e., Model 1), even after increasing statistical control for a wide range of potentially mediating factors, including additional socio-demographic characteristics, the child's gestational and birth characteristics, academic skills proficiency, and behavior (i.e., Models 2-4). Second, we were able to provide relatively precise estimates of any particular factor's effect, after all other factors had been statistically controlled (i.e., Model 4). This is again because the extensive data available in the ECLS-B allowed us to simultaneously control for many potential confounds when estimating the effects of a particular factor (e.g., very low birthweight).

The third set of analyses investigated whether and to what extent minority children might be under-diagnosed by professionals as having (a) communication problems or (b) attention or learning problems, after again controlling for an increasingly large number of potential confounds (i.e., Models 1-4). This third set of analyses was designed to check the robustness of the overall point estimates for the receipt of EI/ECSE services by children with more specific delay or disability conditions.

All the analytical models incorporated sampling weights and design effects to better account for oversampling of some population subgroups. Use of the sampling weights should also yield more accurate standard errors. The weights help account for the stratified cluster design of the ECLS-B. We performed all our analyses using SAS version 9.1 statistical software. We used odds ratios (ORs) to report coefficients. ORs are used instead of relative risk ratios when conducting logistic regression analyses, although the two effect sizes approximate one another for uncommon events, as is the case here. Covariate adjustment is computationally much less complex using ORs than relative risk ratios, and is invariant to operationalizing the event as occurring or not occurring (Simon, 2001). An OR is the odds (i.e., (the probability of an event)/(1-the probability of an event) of experiencing an event for Group A relative to that of Group B (Case, Kimmick, Paskett, Lohman, & Tucker, 2002).

## Results

We conducted three sets of increasingly conservative logistic regression analyses to provide rigorously derived estimates of whether and to what extent minority children in the U.S. may have inequitable access to EI/ECSE services. The first set estimated to what degree minority children displayed very low proficiency levels in two pre-academic skills (i.e., numeracy, receptive language). These analyses were designed to better quantify minority children's relative "need" for EI/ECSE services as a result of a greater risk of delayed acquisition of these skills. The second set of analyses estimated the degree to which minority children were disproportionately represented in the receipt of EI/ECSE services. These analyses increasingly controlled for a wide range of potential confounding factors. We then conducted a third set of follow-up analyses of specific delay or disability conditions in order to examine the robustness of our results. Each set of analyses statistically controlled for variation that was attributable to factors other than children's race/ethnicity, including additional socio-demographics, gestational and birth conditions, and the frequency of their externalizing and internalizing problem behaviors.

Table 1 displays descriptive statistics of the ECLS-B full (i.e., nationally representative) and analytical samples. These descriptive statistics indicate that the two samples very closely approximated each other on the observed background characteristics, including those of race/ethnicity, family SES, and gestational and birth conditions. For instance, the relative percentages of children in the full and analytical samples who were Black were both 14%. The percentages of the samples who were born either pre-term or with low birthweight were also the same.

<Insert Table 1 here>

Table 2 displays descriptive statistics of the two ECLS-B analytical sub-samples of children who were not (*n*=7,248) or who were (*n*=441) receiving EI/ECSE services. Children were more likely to receive these services if they (a) were male, (b) experienced medical risks during their birth, (c) had a mother who drank or smoked during the pregnancy, (d) were born with very or moderately low birthweight, (e) were born with congenital anomalies, and (f) had less well-developed receptive vocabularies or numeracy skills, and (g) were engaged in externalizing problem behaviors more frequently. These descriptive statistics indicate possible inequitable access to EI/ECSE services by minority children. Children who are white constitute 56% of the general population of 48-month-old children but 71% of those receiving EI/ECSE services. Children who are black, Hispanic, or Asian constitute 15%, 23%, and 3% of this general population, respectively, but 7%, 17%, and 1% of those receiving services.

<Insert Table 2 here>

## To What Extent are Minority Children in Greater Need for EI/ECSE Services due to their Greater Risk for Numeracy or Language Delays?

Table 3 displays estimates from the first set of logistic regression models. Here the criterion variable is whether a child displayed a very low level of knowledge about numeracy or receptive vocabulary. These analyses help investigate the degree to which children of racial/ethnic minority heritage and/or lower SES might be considered as more likely to need EI/ECSE services due to possible delays in their pre-academic skill proficiency. We operationalized a very low level of proficiency as having a score in the bottom 10% scores on either measure when administered at 48 months. A 10% cut-off score is a conservative criterion for identifying a child as possibly delayed or disabled (e.g., Catts, Fey, Tomblin, & Zhang, 2002; Geary, 2004; Mazzocco & Myers, 2003; Skibbe et al., 2008). Model 1 adds the child's socio-demographic characteristics. Model 2 adds the family's SES, as well as a range of gestational and birth characteristics. Model 3 adds the frequency of the child's externalizing or internalizing problem behaviors. Model 4 adds whether the child was reported to have an IFSP or IEP, and so receiving EI/ECSE services.

<Insert Table 3 here>

These analyses indicate that children of racial/ethnic minority heritage are more likely to display very low levels of academic skills proficiency. Black, Hispanic, Native-American, and "other" children are more likely than whites to display very low levels of numeracy. Controlling for SES and other variables reduces these effects to statistical non-significance for Blacks. However, children of Hispanic, Native American, and Other racial/ethnic heritage continue to be more likely than whites to display very low levels of proficiency in numeracy even after extensive statistical control (i.e., Model 4's OR range of 1.61-2.93). Children of Hispanic or Asian race/ethnicity are more likely to display very low levels of receptive language proficiency, even after extensive statistical control for confounding characteristics (i.e., Model 4's OR range = 4.99-5.43). Overall, four of the five groups of racial/ethnic minority children display very low levels of academic proficiency in one or both pre-academic skills. This finding is consistent with analyses of the Pre-Elementary Education Longitudinal Study, which indicated that children of racial/ethnic heritage display lower levels of proficiency in numeracy and receptive vocabulary (Markowitz et al., 2006).

Our analyses also indicate very strong effects for SES on children's likelihood of displaying very low levels of early academic skills proficiency. Model 4's ORs for the lowest SES quintile are 8.3 and 8.97 (both *p*<.001). Thus, children in the lowest SES quintile are eight and nine times more likely to display very low numeracy and receptive language skills, respectively, than children in the highest SES quintile. Particularly notable in these data is the linear effect for SES. Although each of the four lower quintiles groups is more likely to display very low levels of early academic skills proficiency relative to those in the fifth and highest quintile group, this likelihood steadily reduces as a group nears the SES of the highest quintile.

## Do Minority Children Have Equitable Access to EI/ECSE Services?

Table 4 displays estimates from four logistic regression models of factors that predict or are associated with children's receipt of EI/ECSE services by 48 months-of-age. Model 1 uses a child's social-demographic characteristics to estimate his or her likelihood of receiving EI/ECSE services. Boys are 2.19 times (*p*<.001) more likely to be identified as disabled or delayed and so receive services than girls. U.S. preschool children who are Black, Hispanic, or Asian are much less likely to receive EI/ECSE services than children who are White (OR range= .24-.56). For instance, children who are Black are approximately a third as likely as children who are White to be identified. The effects for children who are Native American or of other race/ethnicity are directionally consistent but not statistically significant. These estimated ORs for a child's racial/ethnic status are derived after statistically controlling for variation due only to the child's gender or age. Thus, and prior to accounting for the study's other covariates, we observe that children of who are Black, Hispanic, or Asian are already less likely to receive EI/ECSE services in the U.S.

<Insert Table 4 here>

Model 2 adds both the family's socio-demographic characteristics and the child's gestational and birth characteristics to the logistic regression equation. A family's SES is not a statistically significant risk factor, nor is the mother's age or marital status. However, particular gestational and birth characteristics are significant predictors of a child's risk of being identified as disabled or delayed. Children who are very low birthweight are 5.06 times more likely to receive EC/ECSE services. Moderate low birth weight also increases a child's likelihood of such identification. Children born with congenital anomalies are 2.39 times more likely to be receive EI/ECSE services. However, statistically controlling for a family's socio-demographic and a child's gestational and birth characteristics does not greatly reduce a child's racial/ethnic status as a predictor. Preschool children who are Black, Hispanic, or Asian remain less likely to be identified as disabled or delayed and so receive EC/ECSE services than those who are White, even after controls for these other, statistically significant confounds.

Model 3 adds the child's numeracy and receptive language skills. Children with relatively greater numeracy skills are less likely to receive services due to an identified disability or delay (OR=.96). Greater receptive vocabulary skills also reduces this likelihood (OR=.79). Adding a preschool child's relative proficiency in these two skills results in children of very low birthweight having their odds of identification partially explained (i.e. a reduction between Model 2 and Model 3 from 5.06 to 3.81). However, adding a child's level of proficiency in numeracy or receptive vocabulary does not substantially alter the finding that ethnic minority children are under-identified as having disabilities or delays, and so of receiving EI/ECSE services. (Indeed, after these controls, the extent to which Black and Hispanic children are under-identified increases.) With these controls, the odds of receipt of services for children who are Black, Hispanic, or Asian are .26, .36, and .2, respectively, of those of children who are White.

Model 4 adds a child's externalizing and internalizing problem behaviors as confounding factors. Being rated as more frequently displaying externalizing problem behavior increases a child's likelihood of being identified as disabled or delayed and receiving EI/ECSE services (OR=1.1, $p$<.001). Engaging in internalizing problem behaviors more frequently reduces this likelihood (OR=.9, $p$<.05). Adding a child's behavior problems results in only small changes in the estimates of the other predictive or associate factors. Further, inclusion of these additional potentially confounding factors does not change the finding that children of ethnic/racial minority heritage have significantly and substantially less access to EI/ECSE services than children who are white. Instead, and generally, inclusion of the study's confounds *increases* the estimated magnitude of inequitable access. Otherwise identical preschool children who are Black, Hispanic, or Asian are significantly less likely than children who are White to receive EI/ECSE services in the U.S. due to an identified disability or delay (OR range=.21-.41).

Model 4 also indicates that statistically controlling for the aforementioned confounds results in children of low SES being under-identified as delayed or disabled relative to children of high SES. Specifically, children in the lowest or second lowest SES quintiles are .44 and .63 as likely, respectively, to receive EI/ECSE services than children in the highest SES quintile.

## Are Minority Children Under-identified by Professionals as Having Communication, Attention, or Learning Problems?

Tables 5 and 6 display results from two follow up analyses. Specifically, these tables display results from logistic regression models for the two most frequent parent-reported disability or delay conditions. These are a professional's diagnosis of either (a) communication problems or (b) attention or learning problems. Here we use the ECLS-B sample of children whose parents reported that they had been diagnosed as having these problems, regardless of whether the parents also reported that the children had an IEP or IFSP. We hypothesized that some racial/ethnic groups (e.g., Hispanic or Asian children) might be less frequently identified as having communication problems due to possibly being English language learners. However, we hypothesized that such an effect might be less evident for a preschool occurrence of attention or learning problems than for communication. These analyses allowed us to examine whether the pattern of minority under-identification generally was robust across two specific and relatively distinct conditions, as well as whether the results supported our finding of inequitable access by minority children of EI/ECSE services generally. These analyses also allowed us to evaluate the robustness of the observed under-access by lower SES children.

<Insert Table 5 here>

Table 5's results indicate a consistent pattern of minority under-diagnosis for communication disorders or delays. The predicted degree of under-identification is again generally increased after extensive statistical control. In Model 4, the ORs for children who are Black, Hispanic, or Asian are .45, .56, and .22, respectively. Each effect is statistically significant at the $p$<.01 level or greater. Being male, older, or born with congenital anomalies, as well as frequently displaying externalizing problem behaviors, increases a child's likelihood of having a communication problem (OR=1.86, 1.05, 1.9, 1.05, respectively). Children with greater numeracy or receptive language skills are less likely to be diagnosed (OR=.98 and .84, respectively).

Table 5's results also indicate that children from lower SES families are also under-identified. Specifically, and controlling for a range of additional socio-demographic, gestational, and birth characteristics, as well as children's relative early academic skills proficiency and frequency of problem behavior, children of the lowest or second lowest SES were .4 and .6 as likely, respectively, to be diagnosed as having a communication problem as children of the highest SES.

Table 6's results also indicate that minority children are under-diagnosed for attention or learning delays or disorders. Children who are older, whose mothers drank or smoked during their pregnancy, who were born with very low birthweight, and who frequently engage in externalizing problem behaviors are more likely to be diagnosed as having attention or learning problems. In contrast, those who were born very preterm or who were relatively more skilled in their receptive vocabulary or numeracy skills were less likely to have these conditions. Statistically controlling for these and other factors, children who are Black, Asian, Native American, or of other race/ethnicity are less likely than children who are White to be identified (OR range=.21-.58). This statistical control also indicates that children from the lowest three SES quintiles were less likely to be identified as having an attention or learning problem as children from the highest SES quintiles (OR range=.24 to .50).

<Insert Table 6 here>

## Discussion

We sought to identify factors contributing to children's receipt of EI/ECSE services. We were particularly interested in the extent to which children of racial/ethnic minority heritage might have inequitable access to EI/ECSE services. Minority children have been theorized to have more limited access to specialized services (Blanchett et al., 2010). This may occur as a result of social stratification by race, ethnicity, and economic class, which may lower the quality of young children's environments and so negatively impact the development of their cognitive, social, and emotional competencies (Garcia Coll et al., 1996). However, and despite the children's resulting greater risk of displaying delays or disorders, the children's families may underutilize publically available services due to socio-economic, linguistic, and cultural barriers. These racial disparities in educational opportunity should begin to manifest very early on, particularly as minority children transition to preschool (Mickelson, 2003).

To date, only limited empirical evidence for this theoretical account has been available. Relatively few studies have controlled for the socio-demographic, gestational and birth, and learner characteristics (e.g., language delays, frequent problem behaviors) that elevate children's likelihood of receiving services, and so confound any estimates of observed disparities attribute to children's race/ethnicity. Those few studies using extensive statistical control report that minority children are less likely to be provided services (e.g., Hibel et al., 2010; Delgado & Scott, 2006). However, no study has yet been able to evaluate to what extent minority children in the U.S. have inequitable access to EI/ECSE services. This question has important policy-implications, particularly given that the delivery of high-quality EI/ECSE services should help mitigate the impact of delays or disabilities and so increase young children's cognitive, emotional, and behavioral capacities.

Our results indicated that children of racial/ethnic minority heritage do not have the same access to EI/ECSE services in the U.S. as children who are white. Disparities are evident both before and after statistical control for a wide range of potentially confounding factors (e.g., gender, low birthweight, frequency of problem behavior). These disparities are evident despite the potentially confounding factors occasionally yielding strong effects, particularly SES, male gender, very low birthweight and being born with congenital anomalies. Inclusion of the study's confounds generally *increased* the estimated magnitude of delay or disability under-identification for minority children. Additionally, minority children were less likely to receive EI/ECSE services despite being more likely to display very low levels of proficiency in receptive vocabulary or numeracy. These children's greater risk for very low levels of early academic skills proficiency was still evident after extensive statistical control, including for the very strong effects of low SES. Children from low SES families were less likely to access EI/ECSE services. This was the case after variation attributable to many additional confounding factors (including the children's race/ethnicity) had been statistically controlled. The SES estimates indicated a linear relation, in that increased SES was associated with an increased likelihood of receiving services. Our follow up analyses further investigated the observed patterns of inequitable access. These analyses again yielded evidence of under-identification. Children who were of racial/ethnic minority heritage were less likely to be diagnosed as having communication problems or attention or learning problems, regardless of whether they also received EI/ECSE services. Thus, our analyses indicated that children who are minorities or from low SES families have comparatively less access to EI/ECSE services generally, and are less likely to be diagnosed by professionals for specific conditions. This is again despite these children's greater likelihood of displaying language or numeracy delays.

## Study's Limitations

This study investigated disability or delay identification at a particular time point (i.e., by 48 months). Thus, we are unable to report on the extent to which the racial/ethnic patterns reported here (i.e., less frequent receipt of EI/ECSE services) continues as children age. It may be the case that the effects of some factors (e.g., children's other socio-demographic characteristics) begin to exert increasingly strong effects, while the effects of other factors (e.g., children's gestational or birth characteristics) gradually decrease. Our study relied on parental report that the child had an IEP or IFSP, and so had been identified as disabled or delayed and receiving EI/ECSE services. We are unable to independently confirm the extent to which parents reliably report such information. However, multiple features of these data (i.e., the observed prevalence rate, the sample's composition, its greater likelihood of displaying very low levels of numeracy and receptive language proficiency) provided repeated evidence that parents accurately reported whether their children had been diagnosed as delayed or disabled and so were receiving EI/ECSE services. Other investigators have found that parents can accurately identify cognitive and behavioral delays in young children at risk for disabilities (Glascoe & Dworkin, 1995; Johnson et al., 2004; Johnson et al., 2008).

We are also unable to report on the directionality of some of the effects we report. The child's gender, racial/ethnic status, and birthweight can reasonably be characterized as exogenous to his or her receipt of EI/ECSE services due to an identified disability or delay by 48 months of age. However, other factors included in our analyses, such as a child's proficiency in receptive language or numeracy and the frequency of his or her problem behaviors may be endogenous. For instance, it is possible that the child's receipt of EI/ECSE services earlier on might itself have increased the child's frequency of externalizing problem behavior (Morgan et al., 2009). We are also unable to report on the mechanisms responsible for minority and lower SES children's disproportionate under-representation in delivered services. Our study cannot explain *why* children of ethnic/racial minority heritage are less likely to receive EI/ECSE services due to identified disabilities or delays (or be diagnosed as having communication, attention, or learning problems) than children who are white. Further study is needed to identify these causal mechanisms (Garcia Coll et al., 1996; Skiba et al., 2008).

## Study's Contributions and Implications

Our study's results have implications for theory, policy, and practice. Our results are consistent with theories (e.g., Garcia Coll et al., 1996; Mickelson, 2003) positing that minority families may be more likely to display cognitive or behavioral delays, and so be in greater relative need for EI/ECSE services, and yet be less likely to access these services. Garcia Coll et al.'s integrated model included both race/ethnicity and socio-economic class as social stratification factors. We find that the same general pattern holds for both minority and lower SES children, in that these children's families are less likely to access EI/ECSE services, despite potentially their greater need. Other investigators (i.e., Hebbeler et al., 2007) have also reported evidence of inequitable access to EI/ECSE services by minority families. Our analyses of the ECLS-B both corroborate and extend this finding. Hebbeler et al.'s findings were based on a nationally representative sample of children receiving EI services. We find evidence of inequitable access in a nationally representative of children born in the U.S., after more extensive statistical control, and for both the receipt of services generally and in the diagnosis by professionals of two more specific conditions.

There are many factors that should result in minority children having inequitable access to EI/ECSE services. Examples include poverty, racism, a lack of social capital, and the unavailability of culturally-sensitive services (e.g., Blanchett et al., 2010). Because they inter-relate, these factors should result in a complex, cumulating dynamic (Garcia Coll et al., 1996; Mickelson, 2003; Rimm-Kaufman & Pianta, 2000). We are unable to report on *why* minority children are being under-served by EI/ECSE services. However, prior empirical work has been unable to provide rigorously derived estimates as to *whether* minority children have equitable access to EI/ECSE. This is despite theoretical accounts that such disparities may be occurring. Thus, our empirical study helps to confirm these theoretical accounts, and helps justify the need for further empirical study of the causes of these disparities.

Our results should also contribute to policy. Minority children's identification as delayed or disabled has been the subject of (a) two National Research Council reports (Donovan & Cross 2002; Heller, Holtzman, & Messick, 1982), (b) policy briefs by major professional organizations (e.g., National Education Association, 2007), and (c) over 40 years of compliance monitoring (e.g., U.S. Department of Education's Office of Civil Rights, 2009), and has been characterized as one of the special education field's "most long-standing and intransigent" problems (Skiba et al., 2008, p. 264). The 2004 reauthorization of the Individuals with Disabilities Education Act includes amendments (e.g., Section 618) requiring states and localities to monitor children's placement into special education by race and ethnicity to determine whether "inappropriate over-identification or disproportionate representation" has occurred (U.S. Department of Education, 2007, p. p. 1). Corrective action is mandated because disproportionate representation is taken as evidence of bias and potential discrimination (Coutinho & Oswald, 2000). However, most investigations indicate that minority children are disproportionately over-identified as disabled or delayed (e.g., Scarborough, 2004), despite increasing evidence that minority children may in fact be under-identified (e.g., U.S. Department of Education, 2007), especially as investigators begin to account for variation attributable to the greater exposure of minority children to those factors (e.g., poverty, low birthweight) that themselves contribute to children's risk of delays or disabilities. Our study contributes to this work, particularly by establishing that disproportionate representation occurs very early on, well before minority children enter school. Policies that help counteract minority and low-income children's inequitable access to EI/ECSE services are warranted.

From a practical standpoint, results of our study should contribute to the targeting of more effective screening and service delivery efforts. This is because our study identifies factors that either increase or decrease preschool children's likelihood of being identified as disabled or delayed, and so of receiving EI/ECSE services by 48 months of age. Factors that increase this likelihood include being male, older, being born with low birthweight or with congenital anomalies, and engaging more frequently in externalizing problem behavior. Factors that decrease children's likelihood of being identified and receiving EI/ECSE services include the child's race/ethnicity and his or her SES. Our study also evaluates, to an unusually extensive degree, to what extent relatively greater early academic skill proficiency decreases preschool children's likelihood of being identified as disabled or delayed. We find that children who are more proficient in either receptive language or early numeracy are less likely to be so identified. This occurs prior to children's entry into kindergarten. Our use of a large sample, as well as logistic regression models that statistically controlled for an increasingly wide range of socio-demographic, gestational, and birth characteristics, as well as levels of early academic proficiency and problem behaviors, should provide rigorously derived estimates of the effects of each factor.

Our finding that minority children under-receive EI/ECSE services contradicts those reported by Hebbeler et al (2007) and Scarborough et al. (2004). We believe that methodological variation between the studies may account for these conflicting findings, especially because analyses of the ECLS-B provided us with a group of "control" children who did not receive EI/ECSE services. This allowed us to use logistic regression, which in turn allowed us to control for confounding factors that, in the ECLS-B, were extensively detailed. However, results from our study are consistent with three other studies reporting on minority children's receipt of special education services. Hibel et al.'s (2010) analyses of a nationally representative and longitudinal sample indicated that statistically accounting for children's gender, SES, as well as their relative reading and mathematics achievement yielded consistent estimates of minority children's under-identification. Foran's (2007) statistical control for gender, SES, and academic achievement indicated that, for each of three grade levels, minority children in Rhode Island were less likely than white children to receive special education services. Delgado and Scott (2006) analyses of a birth cohort in the state of Florida indicated that both Black and Asian children were less likely than Whites to be referred for special education services by 4 years of age. Our study contributes to this prior work by indicating that controlling for socio-demographic, SES, and achievement confounds continues to yield a consistent pattern of inequitable access. However, our study extends knowledge about "timing," in that disparities in service delivery are starkly evident even by 48 months of age, and these disparities remain evident even after extensive statistical control. Because our analyses used a nationally representative sample, our estimates should better generalize to the population of U.S. preschool-aged children.

Our results are also consist with other work that extensively documents minority children's lack of access to health care, which itself may constitute an explanatory mechanism of these children's observed inequitable access to EI/ECSE services. Pediatricians and other physicians routinely initiate EI/ECSE eligibility evaluations. For example, Palfrey, Singer, Walker, and Butler (1987) estimated that physicians identified 99%, 78%, and 44% of those children receiving EI services for Down syndrome, mental retardation, and hyperactivity, respectively. Identification by a physician also led to earlier diagnosis, with children identified by physicians receiving a diagnosis 2 years earlier on average than those identified by others (e.g., a preschool teacher). Yet Flores and the Committee on Pediatric Research (2010) recently synthesized results from 111 studies and concluded that racial/ethnic disparities in children's health care are “extensive, pervasive, and persistent (p. e979). Empirical studies indicate that a patient’s race can impact a physician’s diagnosis (for a review, see Smedley, Stith, & Nelson, 2003). Shi and Stevens (2005) reported that Black and Hispanic families are twice and three times as likely, respectively, as white families to lack a routine source of health care. Both minority groups are twice as likely to have not visited a health professional or physician in the previous year. Black children are less likely to receive any screening during well child visits (Hambidge, Emsermann, Federico, & Steiner, 2007), and Hispanic children are less likely to receive a referral for specialty care (van Dyck, Kogan, McPherson, Weissman, & Newacheck, 2004), than white children. Black children are less likely to receive a diagnosis for an attention disorder (with or without comorbid learning disabilities) than white children (Pastor & Reuben, 2005). On average, black children receive an autism diagnosis 1.4 years later than white children (Mandell, Listerud, Levy, & Pinto-Martin, 2002). Those minority children who are diagnosed with disabilities were less likely to have access to health care or have visited a physician in the past year, even after controlling for family income and other confounding factors (Newacheck, Hung, & Wright, 2002), as well as to receive “best practice” family-centered care (Coker, Rodriguez, & Flores, 2010). Presumed minority culture’s resistance to accessing health care is not thought to explain these disparities (Smedley, Stith, & Nelson, 2003). Our findings suggest that policies may need to be enacted to ensure that minority children have equal opportunity to access to screening and evaluation for EI/ECSE services, despite these children’s well-documented disparities in health care access generally.

Our analyses indicates that EI/ECSE service delivery in the U.S. can be characterized as in some ways “fair,” and in other ways not. These services are more likely to be provided to children whose characteristics reasonably elevate their likelihood of having delays or disabilities.

For example, children who are more likely to receive EI/ECSE included those who were born with low birthweight, or with congenital anomalies, or displaying very lower levels of proficiency in numeracy or receptive language, or higher levels of externalizing problem behaviors. Yet EI/ECSE services are more likely to not be provided to children who are of racial/ethnic minority heritage, or from low-income homes. This is despite these children's greater likelihood for displaying numeracy and receptive language delays, which should make their receipt of EI/ECSE more likely. These same population sub-groups are likely to lag behind their white peers academically as they move through elementary, middle, and high school (e.g., National Assessment of Educational Progress, 2010).

Klinger et al. (2007) recently surveyed the extant work on race/ethnicity, minority culture, and developmental disabilities, and concluded that "researchers have given inadequate attention to determining how existing identification processes and procedures, assessment tools, and intervention might be made more culturally and linguistically responsive" (p. 56). Our results provide additional context for this assessment. Specifically, our analyses indicate that the disability or delay identification procedures currently being used in the U.S. may not be ensuring that preschool children of racial/ethnic minority heritage have equitable access to EI/ECSE services. This is occurring despite these children's greater likelihood of displaying very low levels of proficiency in pre-academic skills. Children of lower SES are also under-accessing EI/ECSE services. These same two groups of children are also under-diagnosed by professionals as having communication, attention, or learning problems. Yet the receipt of EI/ECSE services has the capacity to positively impact the short- and long-term cognitive and behavioral development of those preschool children who have delays or disabilities (Jenkins et al., 2006; Shonkoff & Hauser-Cram, 1987; Warfield, 1994). Work that identifies and overcomes the cultural, linguistic, and economic barriers resulting in young minority and low-income children's unequal access to EI/ECSE services is clearly needed.

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Table 1:

*Descriptive Statistics for ECLS-B Weighted Full and Analytical Samples*

| | ECLS-B Full Sample (*N*=8,407) | | ECLS-B Analytical Sample (*N*=7,689) | |
|---|---|---|---|---|
| | *M or Proportion of Sample* | *SD* | *M or Proportion of Sample* | *SD* |
| Child is Male | 0.51 | | 0.51 | |
| Child's Age | 52.46 | | 52.49 | |
| White | 0.54 | | 0.56 | |
| Black | 0.14 | | 0.14 | |
| Hispanic | 0.25 | | 0.22 | |
| Asian | 0.03 | | 0.03 | |
| Native American | 0.00 | | 0.00 | |
| Other | 0.04 | | 0.04 | |
| SES, 48 Months, Lowest Quintile | 0.20 | | 0.18 | |
| SES, 48 Months, Second Lowest Quintile | 0.20 | | 0.20 | |
| SES, 48 Months, Middle Quintile | 0.20 | | 0.21 | |
| SES, 48 Months, Second Highest Quintile | 0.20 | | 0.21 | |
| SES, 48 Months, Highest Quintile | 0.20 | | 0.21 | |
| Maternal Age at Child's Birth (=> 35) | 0.14 | | 0.14 | |
| Not Married at 48 Months | 0.34 | | 0.33 | |
| Medical Risks | 0.18 | | 0.18 | |
| Behavioral Risks | 0.11 | | 0.12 | |
| Obstetric Procedures | 0.58 | | 0.59 | |
| Labor Complications | 0.36 | | 0.36 | |

| | | | | |
|---|---|---|---|---|
| Very Pre-term | 0.02 | | 0.02 | |
| Moderately Pre-Term | 0.09 | | 0.09 | |
| Very Low Birth Weight | 0.01 | | 0.01 | |
| Moderately Low Birth Weight | 0.06 | | 0.06 | |
| Congenital Anomalies | 0.05 | | 0.05 | |
| Literacy IRT Score, 48 Months | 12.05 | 8.59 | 13.13 | 7.53 |
| Numeracy IRT Score, 48 Months | 20.81 | 10.10 | 22.50 | 7.51 |
| Color Knowledge Score, 48 Months | 7.87 | 4.32 | 8.77 | 2.27 |
| Receptive Language Score, 48 Months | 7.80 | 3.74 | 8.56 | 1.93 |
| Externalizing Problem Behavior Scale | | | 18.97 | 4.84 |
| Internalizing Problem Behavior Scale | | | 4.05 | 1.35 |
| Has IEP or IFSP, 48 Months | | | 0.04 | 0.23 |

*Note.* SES=Socioeconomic status; IEP=Individualized Education Program; IFSP=Individualized Family Services Plan; IRT=item response theory. The majority of table values in columns “M or proportion of sample” should be interpreted as percentages.

Table 2:

*Descriptive Statistics of ECLS-B Analytical Sample for Children without and with Parent-Reported IEPs or IFSPs (N=7,689).*

| | *Children without parent-reported IEPs or IFSPs (n=7,248)* | | *Children with parent-reported IEPs or IFSPs (n=441)* | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| Child is Male | 0.5 | | 0.68 | |
| Child's Age | 52.47 | | 53.04 | |
| White | 0.56 | | 0.71 | |
| Black | 0.15 | | 0.07 | |
| Hispanic | 0.23 | | 0.17 | |
| Asian | 0.03 | | 0.01 | |
| Native American | 0 | | 0 | |
| Other | 0.04 | | 0.04 | |
| SES, 48 Months, Lowest Quintile | 0.18 | | 0.15 | |
| SES, 48 Months, Second Lowest Quintile | 0.2 | | 0.23 | |
| SES, 48 Months, Middle Quintile | 0.2 | | 0.23 | |
| SES, 48 Months, Second Highest Quintile | 0.21 | | 0.21 | |
| SES, 48 Months, Highest Quintile | 0.21 | | 0.19 | |
| Maternal Age at Child's Birth (=> 35) | 0.14 | | 0.14 | |
| Not Married at 48 Months | 0.33 | | 0.34 | |
| Medical Risks | 0.18 | | 0.22 | |
| Behavioral Risks | 0.12 | | 0.19 | |
| Obstetric Procedures | 0.59 | | 0.6 | |

| | | | | |
|---|---|---|---|---|
| Labor Complications | 0.36 | | 0.4 | |
| Very Pre-term | 0.02 | | 0.06 | |
| Moderately Pre-Term | 0.09 | | 0.1 | |
| Very Low Birth Weight | 0.01 | | 0.04 | |
| Moderately Low Birth Weight | 0.06 | | 0.09 | |
| Congenital Anomalies | 0.05 | | 0.12 | |
| Numeracy IRT Score, 48 Months | 22.62 | 7.47 | 19.96 | 7.39 |
| Receptive Language Score, 48 Months | 8.6 | 1.93 | 7.89 | 1.89 |
| Externalizing Problem Behavior Scale (0=No externalizing behaviors) | 18.85 | 4.77 | 21.74 | 5.39 |
| Internalizing Problem Behavior Scale (0=No internalizing behaviors) | 4.05 | 1.34 | 4.1 | 1.41 |

*Note.* SES=Socioeconomic status; IEP=Individualized Education Program; IFSP=Individualized Family Services Plan; IRT=item response theory.

Table 3:

*Logistic Regression Models (Odds Ratios) of Very Low Numeracy or Receptive Language Proficiency at 48 Months (N=7,689)*

| | Very Low (Bottom 10%) Numeracy Proficiency | | | | Very Low (Bottom 10%) Receptive Vocabulary Proficiency | | | |
|---|---|---|---|---|---|---|---|---|
| | *Model1 1* | *Model 2* | *Model 3* | *Model 4* | *Model 1* | *Model 2* | *Model 3* | *Model 4* |
| | *Child's socio-demographics* | *Family's socio-demographics, child's gestational and birth characteristics* | *Child's frequency of externalizing or internalizing problem behaviors* | *Child's status as disabled or delayed* | *Child's socio-demographics* | *Family's socio-demographics, child's gestational and birth characteristics* | *Child's frequency of externalizing or internalizing problem behaviors* | *Child's status as disabled or delayed* |
| Child is Male | 1.54*** | 1.60*** | 1.42** | 1.40** | 1.54*** | 1.54*** | 1.46** | 1.42** |
| Child's Age | 0.84*** | 0.83*** | 0.83*** | 0.83*** | 0.90*** | 0.89*** | 0.90*** | 0.89*** |
| Black | 2.75*** | 1.29 | 1.25 | 1.30 | 1.35 | 0.77 | 0.80 | 0.86 |
| Hispanic | 2.60*** | 1.48** | 1.55** | 1.59*** | 8.15*** | 5.02*** | 5.10*** | 5.43*** |
| Asian | 0.71 | 0.85 | 0.91 | 0.94 | 4.06*** | 4.55*** | 4.62*** | 4.99*** |
| Native American | 4.67*** | 2.94*** | 2.87*** | 2.93*** | 2.73** | 1.86 | 1.82 | 1.88 |
| Other | 2.13*** | 1.55* | 1.58* | 1.61* | 0.63 | 0.51* | 0.53 | 0.54 |
| SES, Lowest Quintile | | 9.34*** | 8.17*** | 8.30*** | | 8.89*** | 8.58*** | 8.97*** |
| SES, Second Lowest Quintile | | 5.25*** | 4.61*** | 4.65*** | | 5.09*** | 4.94*** | 5.07*** |
| SES, Middle Quintile | | 3.29*** | 3.05*** | 3.07*** | | 2.55*** | 2.51*** | 2.51*** |
| SES, Second Highest Quintile | | 1.95** | 1.84* | 1.84* | | 1.82* | 1.80* | 1.81* |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Maternal Age at Child's Birth (> or = to 35) | 0.91 | 0.92 | 0.92 | | 1.31 | 1.36 | 1.37* |
| Not Married at 48 Months | 1.33* | 1.29 | 1.28 | | 0.81 | 0.79* | 0.79* |
| Medical Risks | 1.11 | 1.10 | 1.10 | | 1.09 | 1.09 | 1.09 |
| Behavioral Risks | 0.98 | 0.96 | 0.95 | | 0.57** | 0.56** | 0.54** |
| Obstetric Procedures | 0.89 | 0.89 | 0.89 | | 1.00 | 0.98 | 0.99 |
| Labor Complications | 1.08 | 1.07 | 1.07 | | 1.01 | 1.01 | 1.01 |
| Very Pre-term | 1.01 | 0.99 | 1.01 | | 0.77 | 0.78 | 0.80 |
| Moderately Pre-Term | 1.04 | 1.04 | 1.05 | | 0.93 | 0.91 | 0.92 |
| Very Low Birth Weight | 2.97*** | 2.79*** | 2.52** | | 3.03*** | 2.87*** | 2.38** |
| Moderately Low Birth Weight | 1.56*** | 1.50** | 1.48** | | 1.34 | 1.33 | 1.28 |
| Congenital Anomalies | 0.91 | 0.88 | 0.85 | | 1.29 | 1.26 | 1.19 |
| Externalizing | | 1.07*** | 1.07*** | | | 1.03* | 1.02 |
| Internalizing | | 0.90* | 0.90* | | | 1.07 | 1.08 |
| IEP or IFSP | | | 1.93** | | | | 3.41*** |

Table 4.

*Logistic Regression Models (Odds Ratios) Estimating Child's Likelihood of Parent-Reported IEP or IFSP at 48 months, ECLS-B data (N=7,689)*

| | *Model 1* | *Model 2* | *Model 3* | *Model 4* |
|---|---|---|---|---|
| | *Child's socio-demographics characteristics* | *Family's socio-demographic characteristics, child's gestational and birth characteristics* | *Child's numeracy and receptive language skill proficiency* | *Child's frequency of externalizing and internalizing problem behaviors* |
| Child is Male | 2.19*** | 2.24*** | 1.96*** | 1.71** |
| Child's Age | 1.04 | 1.03 | 1.1*** | 1.09*** |
| Black | 0.37*** | 0.32*** | 0.26*** | 0.24*** |
| Hispanic | 0.56** | 0.55** | 0.36*** | 0.41*** |
| Asian | 0.24*** | 0.28*** | 0.2*** | 0.21*** |
| Native American | 0.93 | 0.82 | 0.61 | 0.62 |
| Other | 0.75 | 0.66 | 0.62 | 0.62 |
| SES, 48 Months, Lowest Quintile | | 1.12 | 0.5 | 0.44* |
| SES, 48 Months, Second Lowest Quintile | | 1.33 | 0.73 | 0.63* |
| SES, 48 Months, Middle Quintile | | 1.26 | 0.81 | 0.79 |
| SES, 48 Months, Second Highest Quintile | | 1.14 | 0.85 | 0.83 |
| Maternal Age at Child's Birth (=> 35) | | 1.08 | 1.14 | 1.16 |
| Not Married at 48 Months | | 1.17 | 1.16 | 1.12 |
| Medical Risks | | 1.07 | 1.07 | 1.1 |

| | | | |
|---|---|---|---|
| Behavioral Risks | 1.32 | 1.3 | 1.22 |
| Obstetric Procedures | 0.91 | 0.91 | 0.91 |
| Labor Complications | 1.03 | 1.05 | 1.05 |
| Very Pre-term | 0.89 | 0.91 | 0.86 |
| Moderately Pre-Term | 0.86 | 0.8 | 0.81 |
| Very Low Birth Weight | 5.06*** | 3.81*** | 3.86*** |
| Moderately Low Birth Weight | 1.7** | 1.57* | 1.55* |
| Congenital Anomalies | 2.39*** | 2.3*** | 2.22*** |
| Numeracy IRT Score, 48 Months | | 0.96*** | 0.97* |
| Receptive Language Score, 48 Months | | 0.79*** | 0.8*** |
| Externalizing Problem Behaviors Scale, 48 Months | | | 1.1*** |
| Internalizing Problem Behaviors Scale, 48 Months | | | 0.9* |

*Note.* SES=Socioeconomic status; IEP=Individualized Education Program; IFSP=Individualized Family Services Plan; IRT=item response theory; *p<.05; **p<.01; p<.001.

Table 5.

*Logistic Regression Models (Odds Ratios) Estimating Child's Likelihood of Parent-Reported Professional's Diagnosis of Communication Problem at 48 months, ECLS-B data (N=7,689).*

| | *Model 1* | *Model 2* | *Model 3* | *Model 4* |
|---|---|---|---|---|
| | *Child's socio-demographics characteristics* | *Family's socio-demographic characteristics, child's gestational and birth characteristics* | *Child's numeracy and receptive language skill proficiency* | *Child's externalizing and internalizing problem behaviors* |
| Child is Male | 2.16*** | 2.19*** | 1.99*** | 1.86*** |
| Child's Age | 1.02 | 1.01 | 1.06** | 1.05* |
| Black | 0.5*** | 0.51*** | 0.44*** | 0.45*** |
| Hispanic | 0.65** | 0.72 | 0.53** | 0.56** |
| Asian | 0.25*** | 0.27*** | 0.22*** | 0.22*** |
| Native American | 0.83 | 0.79 | 0.62 | 0.62 |
| Other | 0.77 | 0.73 | 0.7 | 0.7 |
| SES, 48 Months, Lowest Quintile | | 0.74 | 0.41** | 0.4*** |
| SES, 48 Months, Second Lowest Quintile | | 0.97 | 0.64* | 0.6** |
| SES, 48 Months, Middle Quintile | | 1.04 | 0.76 | 0.76 |
| SES, 48 Months, Second Highest Quintile | | 1.08 | 0.88 | 0.87 |
| Maternal Age at Child's Birth (=> 35) | | 1.07 | 1.11 | 1.13 |
| Not Married at 48 | | 1.08 | 1.07 | 1.05 |

| | | | |
|---|---|---|---|
| Months | | | |
| Medical Risks | 1.19 | 1.19 | 1.2 |
| Behavioral Risks | 1.32 | 1.31 | 1.27 |
| Obstetric Procedures | 0.88 | 0.88 | 0.87 |
| Labor Complications | 1.06 | 1.07 | 1.07 |
| Very Pre-term | 1.45 | 1.43 | 1.43 |
| Moderately Pre-Term | 1.24 | 1.16 | 1.15 |
| Very Low Birth Weight | 2.48* | 2.06 | 2.01 |
| Moderately Low Birth Weight | 1.04 | 0.99 | 0.98 |
| Congenital Anomalies | 2.01** | 1.95** | 1.9** |
| Numeracy IRT Score, 48 Months | | 0.97** | 0.98* |
| Receptive Language Score, 48 Months | | 0.84*** | 0.84*** |
| Externalizing Problem Behaviors Scale, 48 Months | | | 1.05*** |
| Internalizing Problem Behaviors Scale, 48 Months | | | 1.04 |

*Note.* Communication problem diagnosis $n$=603; SES=Socioeconomic status; IRT=item response theory. *$p$<.05; **$p$<.01; $p$<.001

Table 6.

*Logistic Regression Models (Odds Ratios) Estimating Children's Likelihood of Parent-Reported Professional's Diagnosis of Attention or Learning Problems at 48 months, ECLS-B data (N=7,689).*

| | *Model 1*<br>*Child's socio-demographics characteristics* | *Model 2*<br>*Family's socio-demographic characteristics, child's gestational and birth characteristics* | *Model 3*<br>*Child's numeracy and receptive language skill proficiency* | *Model 4*<br>*Child's externalizing and internalizing problem behaviors* |
|---|---|---|---|---|
| Child is Male | 2.13*** | 2.17*** | 1.81** | 1.45 |
| Child's Age | 1.03 | 1.02 | 1.11*** | 1.09*** |
| Black | 0.66 | 0.56* | 0.44** | 0.44* |
| Hispanic | 0.93 | 0.97 | 0.54* | 0.65 |
| Asian | 0.26*** | 0.33** | 0.2*** | 0.21*** |
| Native American | 0.43 | 0.35* | 0.23** | 0.23** |
| Other | 0.76 | 0.63 | 0.58* | 0.58* |
| SES, 48 Months, Lowest Quintile | | 1 | 0.31** | 0.24*** |
| SES, 48 Months, Second Lowest Quintile | | 1.2 | 0.52* | 0.38*** |
| SES, 48 Months, Middle Quintile | | 1.04 | 0.53* | 0.5* |
| SES, 48 Months, Second Highest Quintile | | 1.08 | 0.69 | 0.65 |
| Maternal Age at Child's Birth (=> 35) | | 0.95 | 1 | 1.04 |

| | | | |
|---|---|---|---|
| Not Married at 48 Months | 1.51 | 1.5 | 1.46 |
| Medical Risks | 1.04 | 1.05 | 1.08 |
| Behavioral Risks | 2.04*** | 2.1*** | 1.96** |
| Obstetric Procedures | 1.06 | 1.05 | 1.03 |
| Labor Complications | 0.97 | 0.99 | 1.01 |
| Very Pre-term | 0.63 | 0.57 | 0.51* |
| Moderately Pre-Term | 1.5 | 1.37 | 1.38 |
| Very Low Birth Weight | 5.55*** | 4.16*** | 4.26*** |
| Moderately Low Birth Weight | 0.95 | 0.87 | 0.88 |
| Congenital Anomalies | 1.72 | 1.58 | 1.48 |
| Numeracy IRT Score, 48 Months | | 0.95*** | 0.97* |
| Receptive Language Score, 48 Months | | 0.68*** | 0.68*** |
| Externalizing Problem Behaviors Scale, 48 Months | | | 1.17*** |
| Internalizing Problem Behaviors Scale, 48 Months | | | 0.95 |

*Note.* Attention problem or Attention Deficit Hyperactivity Disorder only *n*=273; SES=Socioeconomic status; IRT=item response theory. **p*<.05; ***p*<.01; ****p*<.001.