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Social disparities in early intervention service use and provider-reported outcomes

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Abstract

Objective—To describe social disparities in early intervention service use and provider-reported outcomes.

Methods—Secondary data analysis of administrative data to ascertain EI service use of all EI and discipline-specific services and child and family characteristics. Adjusted logistic regression models estimated the odds of receiving each type of core EI service. Adjusted median regression models estimated differences in EI intensity for each type of core EI service. Adjusted ordinal regression models estimated the association between each type of EI therapy service and provider estimates of children's global functional improvement.

Results—Children with a diagnosis ($b=0.8$ SE=0.2) and those whose caregiver had 12 years of education or less ($b=0.6$ SE=0.3) had higher EI intensity. Black, non-Hispanic (BNH) children had nearly 75% lower odds of receiving physical therapy (PT) [OR=0.3, 95%CI:0.1, 0.7] and greater odds of receiving speech therapy [OR=3.4, 95%CI:1.3, 9.3] than their white, non-Hispanic (WNH) peers. BNH who received PT received about an hour less per month ($b=-0.7$ SE=0.4) than their WNH peers. Hispanic children [$b=1.0$ SE=0.3] and those with higher family income ($b=0.7$ SE=0.3) received greater intensity of PT compared to their peers who are WNH and from low-income families. Publically insured children had lower intensity of OT ($b=-0.5$ SE=0.3) and ST ($b=-0.6$ SE=0.3). Greater intensity of EI services was not associated with greater provider perceived improvement.

Conclusions—Results suggest disparities, by race and family income, in receipt of EI therapy services. These findings highlight opportunities to customize and coordinate care for improved EI access and care quality.

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Keywords

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Part C of the Individuals with Disabilities Education Act (IDEA) authorizes states to provide early intervention (EI) for infants and toddlers with or at risk for developmental delays and disabilities with the incentive of federal financial support.¹ EI is not a single program, but rather includes different packages of services that vary within and across states with regard to delivery models and provider disciplines.² This federal-state partnership allows flexibility to address the diverse medical, developmental, and social needs of families. State flexibility in EI resource allocation and programming has the potential to ensure appropriate EI referrals and to reduce EI access and service use disparities.

In this paper, we describe social disparities in EI service use. Social disparities refer to differences in health and healthcare access that are systematically distributed and stem from varying levels of social disadvantage.³

For example, despite state flexibility in EI spending, previous literature suggests EI access disparities based upon social and developmental risk.^{4,5,6,7} The mechanisms through which families enroll in EI are multi-faceted and in addition to the diagnosis of a developmental condition, also typically require appropriate community outreach, good communication from pediatric providers, and optimal parental knowledge and supportive beliefs about developmental and therapeutic intervention. This constellation of factors influencing EI enrollment can contribute to access disparities. Indeed, a number of studies have shown that children who are black, non-Hispanic,⁴ have a developmental delay,⁵ and those who are poor or publically insured^{3,5,6} are less likely to access EI than children who are white, non-Hispanic and from families with less social risk. Ensuring access to coordinated systems of care for young children with developmental conditions is a national priority for reducing service disparities. For example, the American Academy of Pediatrics endorses universal developmental screening to help facilitate timely EI referral for infants and toddlers with developmental conditions and suspected delay.⁸ Moreover, many states have adopted Maternal and Child Health Bureau performance measures⁹ to ensure appropriate access to EI for children with developmental conditions and delays.

Disparities in EI access may contribute to inequities in EI service use and outcomes, yet there is limited research evidence regarding optimal EI dosage. Although EI programming varies state to state, core EI services exist in all states and include physical, occupational, and speech therapy, and special instruction (i.e., early childhood special education or developmental specialist) while some programs also provide psychology services. Previous research from a national EI sample¹⁰ provides descriptive evidence about EI service use. Specifically, about one-third of children receive up to one hour of EI services per week, nearly one-third of children receive 1–2 hours of services per week, and one-third receive more than two hours of services weekly. Moreover, 40–50% receive therapy (i.e., physical, occupational, or speech therapy) EI services. However, these data did not examine service use differences by child and family characteristics. More recently, analyses of data from a

state early intervention program¹¹ suggested that children who received greater number of hours and intensity of EI services were more likely to be younger at EI entry, insured, and non-poor. However, this study did not examine differences in EI use by type of core EI service, and did not examine differences in EI service use by racial and ethnic sub-groups or developmental condition. There is evidence to suggest that minority, poor, under insured children and those with more severe conditions were least likely to have their therapy needs met.^{12,13} However, these studies examined unmet need for therapy, generally, and was not specific to EI so it is unclear if similar disparities would persist among an EI-enrolled cohort. Finally, there is a paucity of extant literature linking EI service use with outcomes. Prior research has described associations between child and family characteristics and parent-reported outcomes¹⁴ and improvement following EI services overall.⁹ Yet, it is not clear how service use (i.e., type, amount, duration, or intensity) is associated with more optimal EI outcomes.

Greater specificity in knowledge about disparities in EI service use and outcomes may highlight opportunities to customize and coordinate care for improved EI care quality. This study was undertaken in order to leverage existing electronic administrative data on discharged families in order to describe specific EI service use patterns and outcomes. The primary purpose of this study is to describe disparities in discipline-specific EI service use patterns. We also sought to describe the association between EI service use (overall and discipline-specific) and provider perceptions of the child's improvement upon EI discharge.

METHODS

Study Sample

The study sample was derived from electronic administrative data at an EI program in XXX, Colorado. This EI program is located within the XXXX (Blinded). The EI program has a 20-year history of providing EI services to approximately 125 families annually. The study sample included children who met the following inclusion criteria: 1) discharged from the EI program between 7/1/2010 and 6/30/15, and 2) had at least one EI service.

Measures

EI Service Use—The primary outcome of interest was EI service use. In this study, EI services most often occur in the families' homes. Although the services are provided during typical business hours, efforts are made to accommodate family schedules (e.g., evening home visits). Overall EI service use was described according to number of services (sum of discipline-specific services received [1, 2, 3 or more]), total number of EI hours, and total duration of EI services (in months). Overall EI intensity, categorized as the number of all EI service hours per month, was calculated as the total EI hours divided by the total duration of EI services (in months). To estimate discipline-specific service use (i.e., the type of service, according to the provider discipline, for example physical therapy), we estimated 1) whether children received "any" discipline-specific services and 2) the intensity of each discipline-specific service. Children were categorized as receiving "any" discipline-specific service if they received at least one billable service from that discipline (e.g., physical therapy [PT], occupational therapy [OT], speech therapy [ST], psychology, or developmental specialist

[DS]. A DS typically has a background in early childhood special education or early childhood development. Discipline-specific service intensity was calculated as the total number of service hours for each discipline, divided by the total duration of EI services for that discipline (in months).

Provider Rating of Child's EI Improvement—A secondary outcome of interest was providers' rating of the child's EI improvement. This single item is routinely administered at the time when the child's EI record is archived and the Child Outcomes Summary form¹⁵ and exit developmental evaluation have been completed. The single-item rating captures EI provider perceptions of the child's overall progress between EI entry and EI exit (5-point scale, ranging from 1 [no improvement] to 5 [excellent improvement]). This item was developed by the EI program director and intended for internal use. The item has been routinely administered for nearly 10 years, and all program staff received training from the program director. There is no reliability and validity evidence for this measure, but sample score distribution is similar to national estimates of children's progress between early intervention and exit.¹⁶

Child and Family Characteristics—Reason for the child's EI eligibility was categorized according to child's developmental condition type. Specifically, children are eligible for EI based upon a developmental condition, (i.e., an established condition or developmental delay). An established condition is a diagnosis that typically results in developmental delay so the child is automatically deemed to be EI eligible. These conditions are based upon federal legislation¹ and states can choose to include additional diagnoses. The EI program engaged in this study draws on their state's database to identify those developmental conditions that are associated with automatic EI eligibility.¹⁷ Moreover, in CO, children are eligible for EI based upon the presence of a developmental delay, determined by a multidisciplinary developmental evaluation administered by the EI team. Child's race and ethnicity was categorized as white, non-Hispanic (WNH); black, non-Hispanic (BNH); Hispanic; and other race, non-Hispanic (ONH; includes Asian, Pacific Island and children reporting more than one race). Highest parental education level was grouped as 12 years or less; between 13 and 15 years; and 16 or more years. Annual household income was categorized as less than \$50,000 or \$50,000 or more. We also included a measure of child's sex (male/female) and the primary language spoken at home (English vs a language other than English). Insurance type was categorized as private or public (includes Medicaid and Children's Health Insurance Program [CHP+]).

Analytic Approach

We first calculated descriptive statistics for select child and family characteristics and EI service use. For continuous variables, we calculated sample means, medians, and standard deviations. For continuous variables with a non-normal distribution, we additionally calculate inter-quartile ranges. Sample proportions were calculated for each categorical variable.

We described the associations between child and family characteristics and EI service use in two ways. First, we estimated unadjusted odds of receipt of "any" of discipline-specific EI

services, controlling for each child and family characteristic, by estimating a series of bi-variable logistic regression for each discipline. To estimate the unadjusted associations between each child and family characteristic and EI intensity, we fit a series of bi-variable median regression models. We first fit a series of models describing overall EI use and then fit a series of models describing service use by professional discipline (i.e., PT, OT, ST, and DS). Given the small sub-sample of children who received services from a psychologist, a model examining predictors of any (yes/no) or intensity of psychology services was not estimated. Median regression models the median rather than the mean and is appropriate for skewed data. We then estimated, for each discipline-specific service, a multivariable logistic regression model that included all child and family characteristics. These models represent the adjusted odds of receiving “any” of the discipline-specific services. Finally, we estimated a series of multivariable median regression models, first describing overall EI intensity and then fit a series of models describing EI intensity by discipline.

In order to describe the association between service use and provider-reported global improvement, we estimated a series of ordinal logistic regression models. Ordinal logistic regression models are appropriate for ordinal data and the model coefficients are interpreted as the association between each child and family characteristic on the odds of demonstrating a higher (i.e. more optimal) improvement category than a lower one (i.e., less improvement). The first model included EI intensity in addition to the child and family characteristics. Three additional adjusted ordinal regression models included discipline-specific (i.e., PT, OT, and ST) EI intensity as well as the child and family characteristics. These discipline-specific models were conditional on receipt of “any” of the respective discipline-specific service. Given the small sub-sample of children receiving DS, a separate model examining the association between DS intensity and provider-reported global improvement was not estimated. The final adjusted ordinal logistic regression model included count of EI providers, EI intensity, and the child and family characteristics. For the adjusted ordinal regression models, we present an odds ratio and 95% CI for each model parameter.

RESULTS

The sample included 457 children as described in Table 1. Children were predominantly male (65.7%), white, non-Hispanic (59.7%), and spoke English as their primary language (89.5%). More than half of the parents had at least 16 years of education (54.1%) and earned \$50,000 or more annually (58.3%). Nearly 1/5 (17.7%) of the sample was publically insured, and about 1 in 5 (22.1%) children had an established condition.

As shown in Table 1, 57.5% received only one EI services whereas 11.8% received three or more EI services. Moreover, 38.7% of study children received OT, 47.5% received PT, and 55.8% received ST. Moreover, 11.4% of study children received services from a DS. The reasons for relatively low rates of DS service use are not known, but could reflect the relatively greater availability of pediatric PTs, OTs and STs in urban areas. Children commonly received one EI service (57.5%) versus multiple EI services (11.8%).

The median per child number of total EI hours was 36 [IQR: 18, 67]. Discipline-specific median [IQR] per child number of EI hours were 17.8 [10.4, 45.9] for DS, 7.5 [5.5, 16.1] for

psychology, 24.5 [14, 40] for ST, 18.5 [8, 34] for OT, and 35 [16.5, 62] for PT. Median [IQR] EI intensity (hours per month) was 3.1 [2.0, 4.1] hours per month. Discipline-specific median [IQR] per child EI intensity (hours per month) were 1.39 [0.7, 2.7] for developmental specialist, 2.2 [1.5, 3.0] for PT, 1.6 [0.9, 2.6] for OT, 2.0 [1.1, 3.4] for ST, and 0.9 [0.6, 2.6] for psychology.

Results of the adjusted logistic regression models estimating the odds of receipt of each discipline-specific EI service are presented in Table 2. As compared to children with a developmental delay, those with an established condition have between 2- and 3-fold higher odds of receiving physical therapy (OR=2.3 95% CI=[1.4, 3.9]), occupational therapy (OR=2.5 95% CI=[1.5, 4.3]), and special instruction services (OR=3.5 95% CI=[1.6, 8.0]). Children whose annual family income is at least \$50,000 have twice the odds (OR=2.0, 95% CI=[1.0, 3.9]) of receiving physical therapy as compared to their peers in the lower income category. Children whose primary language is English have lower odds of receiving PT (OR=0.5, 95% CI=[0.2, 1.0]) whereas children who are publically insured (i.e., through Medicaid or CHP+) have twice the odds (OR=2.2, 95% CI=[1.1, 4.0]) of receiving PT. Finally, as compared to their WNH peers, BNH (OR=0.3, 95% CI= [0.1, 0.7]), Hispanic (OR=0.6 95% CI=[0.3, 1.1]), and children from “Other” races (OR=0.4 95% CI= [0.2, 0.8]) have lower odds of receiving PT. Compared to children in the lower income category, children whose family income is at least \$50,000 have 45% and 64% lower odds of receiving ST (OR=0.6 95% CI=[0.3, 1.1]) and DS services (OR=0.4 95% CI=[0.1, 0.9]), respectively. Compared to their WNH peers, BNH children have 3-fold higher odds of receiving ST (OR=3.4 95% CI=[1.3, 9.3]) and DS services (OR=3.9 95% CI=[1.2, 12.6]).

The results of the adjusted median regression models estimating the association between child and family characteristics and intensity of EI services are presented in Table 3. Compared to children with a developmental delay, those with an established condition receive nearly an hour more per month of EI services (b=0.8, SE=0.2). Compared to children whose parents have at least 16 years of education, children whose parents have 12 years of education or less receive approximately 40 more minutes of EI services per month (b=0.6, SE=0.3). The results of the adjusted median regression models estimating the association between child and family characteristics and intensity of discipline-specific EI services are presented in Table 3. Compared to their WNH counterparts, BNH children receive about 45 fewer minutes (b=-0.7, SE=0.4) of PT per month. Compared to children with a developmental delay, those with an established condition receive a higher intensity of PT (b=0.6, SE=0.2) but a lower intensity of ST (b=-0.7, SE=0.4). Compared to children who are privately insured, children with public insurance receive a lower intensity of OT (b=-0.5, SE=0.3) and ST (b=-0.6, SE=0.3). Compared to their WNH peers, Hispanic children receive nearly an hour per month more of OT services (b=1.0, SE=0.3). Finally, compared to children in the lower income bracket, children whose family income is at least \$50,000 per year receive nearly one more hour of OT per month (b=0.7, SE=0.3).

The results of the adjusted ordinal regression models estimating the association between EI service use and provider-reported improvement at EI discharge are presented in Table 4. Children who are ONH had a nearly 70% lower odds of having higher global improvement (OR=0.4, 95% CI: 0.2, 0.8) even controlling for EI intensity child and family characteristics.

In addition, in the discipline-specific models children of an “other” race who received OT (OR=0.3, 95% CI = [0.1, 0.8]) each had nearly 70% lower odds of receiving a better global improvement score than their white, non-Hispanic counterparts receiving OT. For children who are of an “other” race, these results held even after controlling for child and family characteristics, overall EI intensity, as well as provider count.

DISCUSSION

This study used a single administrative database to describe EI service use patterns among children who had received these services from a single program located in XXX (Blinded), Colorado.

Results of this study suggest that sample children on average receive about 2 hours of EI services per month, however there was substantial variability in the amount of EI services received. The most prevalent core service type was speech therapy but the core EI service with greatest total hours was physical therapy. These results are similar to national estimates⁹ suggesting that over half of EI-enrolled children receive speech therapy. Moreover, our findings are consistent with the variety of service intensity received in EI where, among a nationally representative sample of EI children, about 1/3 receive less than 1 hour per month; another 1/3 receive 1–2 hours per month, and 1/3 receive greater than 2 hours per month.⁹

Results of this study also suggest significant social disparities in EI service use generally and by most EI disciplines. For example, compared to their white, non-Hispanic peers, BNH children, most with developmental delay, were not only less likely to receive any PT, but when they did receive PT, it was of a lower intensity. Our study findings are consistent with previous research suggesting that black, non-Hispanic children, especially those with a developmental delay (i.e., versus established condition) are significantly less likely to access EI than their white, non-Hispanic counterparts even controlling for condition severity.⁴ Moreover, previous research also suggests parents of minority children with developmental conditions report a nearly 2-fold higher unmet need for therapy compared to similar white, non-Hispanic parents.¹⁹ To our knowledge, ours is the first study to describe disparities in EI service use generally and with respect to discipline-specific service use.

While the reasons for these differences in service use could not be ascertained from this study, results are similar to those reported in prior studies related to EI service access. A recent review by Zuckerman and colleagues¹⁸ examined the extant literature to describe disparities in receipt of early childhood services for children with developmental conditions. Those results suggest that racial differences in care stem from differences in provider behavior and parental perceptions of child development. For example, minority children are less likely to have timely access to primary and specialty care. Limited health care access could translate into fewer opportunities for parents to express developmental concerns and a lack of provider follow-up about developmental concerns based on an abnormal developmental screen that would result in EI referral. Moreover, disparities in healthcare access could mean that minority families are less likely to have a medical home¹⁹ and receive information about the importance of EI therapy participation. As such, these missed

anticipatory guidance opportunities might translate to BNH children receiving less physical therapy than their WNH peers. Zuckerman and colleagues also suggest that healthcare providers are more likely to dismiss parental developmental concerns and abnormal developmental screening results to social risk (i.e., versus medical or developmental condition) for BNH families than WNH, resulting in fewer EI referrals and follow-up regarding developmental services. These provider behaviors could undermine EI outreach efforts to BNH families who are eligible for EI but not identified this way as often in the context of a primary care visit. Finally, cultural differences in parental expectations or their concerns about the face validity of developmental screens that have been critiqued for inherent racial biases,^{18–21} may decrease how often parental concerns are reported by BNH families. Interestingly, we found that Hispanic children received greater OT intensity than WNH peers. Follow-up conversations with the EI program suggest that many staff are bilingual and able to communicate with families in Spanish, perhaps mitigating an important therapy service use barrier for Hispanic families. Future research should explore barriers to EI physical therapy use for BNH families and optimize EI participation.

Moreover, we found that children from families with higher incomes are more likely to receive physical therapy and receive higher intensities of occupational therapy than their low-income counterparts. It is plausible that families with higher incomes have access to additional resources to have greater knowledge, beliefs and expectations related to therapy service use and intensity, which allows them to advocate for greater therapy service delivery. Additionally, families with higher incomes likely have additional resources (e.g., flexible employment, paid time off etc.) that allow for better adherence to a therapy plan of care, particularly services that most often occur during typical work hours and place high demands on parent involvement. For example, most EI therapeutic interventions use mostly face-to-face methods for parental engagement, which requires that the parent be physically present during the EI session.

We also found that children who are publically insured receive less intensive speech therapy than their privately insured counterparts. This finding could be explained, in part, by the finding that children with a developmental diagnosis are less likely to receive speech therapy. That is, public insurance might be marker for not only social disadvantage, but also developmental disability (i.e., children who are dually eligible for social security disability insurance and Medicaid, for example). To this end, children with developmental delays may be accessing speech therapy more often and at greater intensities than their counterparts with established conditions. Indeed, in previous research examining EI relevant sub-groups,²⁰ children with mild developmental delays consistently appear as a clinically and policy-relevant group with nearly 30% of EI-enrolled children having a speech delay and receiving primarily speech therapy services. Further research should explore the extent to which children with developmental disabilities, particularly those who are publically insured, have their speech therapy needs met.

Yet, receipt of public insurance could also be a marker for relative social disadvantage, particularly given that health insurance is not required to access to early intervention and does not drive how much therapy a child receives. Thus, publically insured and low-income

children may lack availability of family resources to adhere to a more intensive occupational, speech, or physical therapy program,

In this study, children with developmental condition that automatically qualifies them for EI (i.e., established condition) receive greater EI service intensity overall, more intensive physical therapy services, but less intensive speech therapy. This finding is consistent with previous literature⁵ suggesting that children with an established condition access EI more often. However, these findings can also contribute to the extant literature to describe service use (i.e., intensity) differences by condition type. However, previous literature also suggests that parents of children with established conditions report more unmet need for therapy than parents of children with developmental delays. Thus, future research should link EI service needs, service use patterns and outcomes to better understand and mitigate disparities in unmet need for children with varying developmental conditions.

In this study, we did not find that service use was associated with perception of improvement. However, we did find that greater intensity of ST services was associated with small odds of lower provider-reported improvement. The positive relationship between service use and outcomes has been reported previously,⁹ but did not fully adjust for child and family characteristics (e.g., family income, maternal education) that confound this association. Moreover, previous research did not address intensity, which is likely a better metric of service use than amount or duration of EI services.

However, we acknowledge the limitations of a single item provider-reported outcome measure. It is possible that biases are introduced when a provider who has been working with a family for an extended time is more likely to report improvement at EI discharge. Alternatively, the provider assigned to this task varies and providers who are less familiar with a child may be less informed and therefore more likely to report improvement. Moreover, differences in provider reported outcomes may also be influenced by provider's expectations for improvement based upon the family's resources. Although the possibility of bias exists, it is minimized because this scale is administered for general program surveillance (i.e., not reported externally) and is reported annually in aggregate by the data manager. Thus, specific scores are not shared with families nor is a specific score tracked to a specific provider-child dyad. An additional limitation is that this measure was collected by provider report and may not capture parental perceptions of the child's overall progress. Future research should explore the role of collecting EI outcome measures that have particular relevance to families. Related, future research should examine the extent to which EI general and discipline-specific service use is linked to attainment of goals delineated in the child's EI care plan (i.e., Individualized Family Service Plan).

We acknowledge the study's limitations. The data were ascertained from one early intervention program, which limits the generalizability of the findings to other EI programs within or outside of Colorado. Yet, where available for comparison, our sample resembles state and national estimates, and our main findings (e.g., percent receiving core discipline-specific services) are consistent with national estimates,⁹ which increases their external validity. Future research should expand the outcome research methods in this study to examine statewide and multi-state trends in EI service use disparities. Related, it is possible

that EI service delivery models (e.g., multidisciplinary, transdisciplinary) influence EI service use data. Per national recommendations,²¹ this EI program utilizes a transdisciplinary model and future research should investigate the role of service delivery models on EI service use and outcomes. Secondly, this study identifies social disparities in service amount but not EI care quality according to best practices.²¹ Differences in EI service processes (e.g., family-centered care, care coordination and service delivery model, cultural competence) and family engagement will be important to investigate in future research examining social disparities in EI service use, results of which may guide best practices in early intervention. Finally, we included only one, single-item measure of children's global improvement. As noted, this scale has not undergone psychometric testing and may have innate biases. Yet, the purpose of this study was to leverage available data and understand opportunities for improvement in outcomes measurement. Future research should examine the feasibility of implementing additional measures and perspectives on improvement that could capture specific areas of gain.

This study has a number of strengths. Access to a rich EI program database allowed us to describe a broad range of EI service use metrics. We were able to describe service use intensity overall and by service type and our analyses were able to control for a host of child and family characteristics. To this end, the study's findings highlight important racial and ethnic disparities in service use. Finally, the methods used in this study can serve as a model that could be replicated by other EI programs individually or at the state-level to investigate and mitigate service use disparities.

CONCLUSION

The results of this study highlight substantial disparities whereby BNH, low-income, and publically insured children receive less intensive EI therapy services than their WNH peers with less social risk. The findings have important clinical and policy implications for understanding how to best tailor EI messaging and service delivery to assist families in navigating the EI system most efficiently and effectively with an eye toward reducing disparities in care and outcomes. For example, EI providers may need to employ more intensive or alternative strategies to connect with poor and BNH families and to ensure that EI services are well-matched to the family's needs, priorities, and desired outcomes for their child.

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Table I

Characteristics of the Study Sample (n = 457)

	Percentages (%)	n
Child's sex, Male	65.7	300
Primary Language, English	89.5	409
Insurance Type, Medicaid and CHP+	17.7	81
Had a Diagnosis	22.1	101
Race/Ethnicity		
White, non-Hispanic	59.7	273
Black, non-Hispanic	8.8	40
Hispanic	18.8	86
Other, non-Hispanic	12.7	58
Parental Education Level		
12 or less years	50.0	174
12 to 15 years	10.3	36
16 or more years	39.7	247
Family Income		
\$0–9,999	15.5	57
\$10,000–19,999	5.7	21
\$20,000–29,999	8.7	23
\$30,000–39,000	5.2	19
\$40,000–49,999	6.5	24
\$50,000+	58.3	214
Improvement Measure		
1 - No Improvement	0.7	2
2 - Mild or Modest Improvement	15.1	42
3 - Moderate Improvement	21.5	60
4 - Substantial Improvement	33.3	93
5 - Excellent Improvement	29.4	82
<i>Type of EI Services Received</i>		
Physical Therapy	47.5	255
Occupational Therapy	38.7	217
Speech Therapy	55.8	177
Psychologist	1.8	8
Developmental Specialist	11.4	52
<i>Number of EI Services Received</i>		
One	57.5	263
Two	30.7	140
Three or more	11.8	54

	Percentages (%)	n
Length of Services (mean & sd)	15.0 (9.5)	
Intensity of Services (mean & sd)	8.7 (79.5)	
	Mean (SD)	Median [IQR]
<i>Total Per Child Hours of EI Services, Conditional on Any Use</i>		
All Services	85.3 (567.1)	36 [18, 67]
Physical Therapy	42.1 (35.1)	35 [16.5, 62]
Occupational Therapy	105.6 (893.9)	18.5 [8, 34]
Speech Therapy	29.0 (19.5)	24.5 [14, 40.3]
Psychologist	11.9 (11.3)	7.5 [5.5, 16.1]
Developmental Specialist	64.4 (265.7)	17.8 [10.4, 45.9]
<i>Total Per Child Intensity of EI Services, Conditional on Any Use</i>		
All Services	8.7 (79.5)	3.0 [2.0, 4.1]
Physical Therapy	3.3 (11.7)	2.2 [1.5, 3.0]
Occupational Therapy	12.9 (126.1)	1.6 [0.9, 2.6]
Speech and Language Pathology	2.5 (2.8)	2.0 [1.1, 3.4]
Psychologist	2.0 (2.3)	0.9 [0.6, 2.6]
Developmental Specialist	5.5 (19.6)	1.4 [0.7, 2.7]

Table 2

Adjusted Odds Ratios and 95% Confidence Intervals of Receiving Discipline-Specific Early Intervention (EI) Services (n=457)

<i>Independent Variables</i>	Odds of any PT	Odds of Any OT	Odds of Any ST	Odds of Any DS
Had a Diagnosis	2.3** [1.4, 3.9]	2.5** [1.5, 4.3]	1.1 [0.7, 1.9]	3.5** [1.6, 8.0]
Insurance Type, Medicaid and CHP+	2.1* [1.1, 4.0]	0.7 [0.4, 1.4]	1.0 [0.5, 1.9]	2.1 [0.8, 5.1]
Primary Language, English	0.4* [0.2, 1.0]	1.0 [0.4, 2.2]	1.0 [0.5, 2.2]	2.1 [0.7, 6.9]
Family Income				
\$0–49,999	<i>ref</i>	<i>ref</i>	<i>ref</i>	<i>ref</i>
\$50,000+	2.0* [1.0, 3.9]	1.0 [0.5, 2.1]	0.6 [0.3, 1.1]	0.4* [0.1, 0.9]
Parental Education Level				
12 or less years	2.0 [0.9, 4.6]	1.0 [0.5, 2.3]	1.9 [0.8, 4.1]	2.5 [0.7, 8.3]
13 to 15 years	0.7 [0.3, 1.6]	1.3 [0.6, 2.8]	2.0 [0.9, 4.3]	2.7 [0.9, 8.5]
16 or more years	<i>ref</i>	<i>ref</i>	<i>ref</i>	<i>ref</i>
Race/Ethnicity				
White, non-Hispanic	<i>ref</i>	<i>ref</i>	<i>ref</i>	<i>ref</i>
Black, non-Hispanic	0.3** [0.1, 0.7]	1.7 [0.7, 4.089]	3.4* [1.3, 9.3]	3.9* [1.2, 12.6]
Hispanic	0.6 [0.3, 1.1]	0.7 [0.3, 1.4]	1.0 [0.5, 1.8]	1.8 [0.6, 5.1]
Other, non-Hispanic	0.4* [0.2, 0.8]	1.5 [0.7, 3.3]	1.1 [0.5, 2.2]	3.6* [1.2, 10.5]

95% Confidence Intervals in brackets

**
p<0.01,

*
p<0.05

PT=Physical Therapy; OT=Occupational Therapy; ST=Speech Therapy; DS=Developmental Specialist

Table 3

Adjusted Median Early Intervention Service Use Intensity (hours / month) (n=457)

<i>Independent Variables</i>	<i>Total Per Child EI Intensity</i>	<i>Total Per Child PT Intensity</i>	<i>Total Per Child OT Intensity</i>	<i>Total Per Child ST Intensity</i>	<i>Total Per Child DS Intensity</i>
Had a Diagnosis	0.8** (0.2)	0.6** (0.2)	-0.4 (0.3)	-0.7** (0.4)	0.9 (1.0)
Insurance Type, Medicaid and CHP+	0.4 (0.3)	0.4* (0.2)	-0.5* (0.3)	-0.6* (0.3)	-0.6 (0.5)
Primary Language, English	0.0 (0.2)	-0.2 (0.2)	0.3 (0.3)	0.5 (0.5)	0.5 (1.1)
Family Income	<i>ref</i>	<i>ref</i>	<i>ref</i>	<i>ref</i>	<i>ref</i>
\$0-49,999	0.0	0.2	0.7*	-0.1	0.5
\$50,000+	(0.3)	(0.3)	(0.3)	(0.4)	(0.8)
Parental Education Level					
12 or less years	0.6* (0.3)	-0.4 (0.2)	-0.3 (0.5)	-0.1 (0.3)	-0.2 (1.0)
13 to 15 years	0.2 (0.3)	-0.6 (0.3)	-0.1 (0.3)	0.0 (0.4)	-1.7 (1.1)
16 or more years	<i>ref</i>	<i>ref</i>	<i>ref</i>	<i>ref</i>	<i>ref</i>
Race/Ethnicity					
White, non-Hispanic	<i>ref</i>	<i>ref</i>	<i>ref</i>	<i>ref</i>	<i>ref</i>
Black, non-Hispanic	0.6 (0.4)	-0.7* (0.4)	1.1* (0.6)	0.0 (0.6)	-1.2 (1.1)
Hispanic	0.0 (0.2)	-0.2 (0.2)	1.0* (0.3)	-0.1 (0.3)	1.4 (1.1)
Other, non-Hispanic	0.3 (0.3)	0.4 (0.3)	0.1 (0.3)	0.8 (0.5)	0.7 (0.9)

Robust standard errors in parentheses

PT=Physical Therapy; OT=Occupational Therapy; ST=Speech Therapy; DS=Developmental Specialist

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*,
**
p<0.01
*
p<0.05

Table 4

Adjusted Ordinal Odds Ratios for the Association Between Early Intervention Service Use Intensity (hours / month) and Provider Rating of Overall Improvement Between Entry and Exit (n=457)

<i>Independent Variables</i>	<i>Adjusted Associations</i>				
	(1) ^a	(2) ^b	(3) ^c	(4) ^d	(5) ^e
Per Child Intensity of EI Services	1.0 [1.0, 1.0]	–	–	–	0.999 [0.990, 1.007]
PT-Specific <i>t</i>	–	1.0 [1.0, 1.0]	–	–	–
OT-Specific <i>t</i>	–	–	1.0 [1.0, 1.0]	–	–
SLP-Specific <i>t</i>	–	–	–	0.9 ^{**} [0.9, 1.0]	–
Count of EI Providers	–	–	–	–	1.1 [0.8, 1.4]
Had a Diagnosis	1.2 [0.7, 2.1]	0.9 [0.4, 2.0]	1.9 [0.7, 4.7]	1.4 [0.7, 2.9]	1.2 [0.6, 2.1]
Insurance Type, Medicaid and CHP+	0.6 [0.3, 1.2]	0.4 [*] [0.2, 1.0]	0.6 [0.2, 1.4]	1.1 [0.4, 3.2]	0.6 [0.3, 1.2]
Primary Language, English	0.7 [0.3, 1.8]	0.9 [0.1, 6.2]	0.7 [0.2, 2.1]	0.9 [0.3, 3.2]	0.7 [0.3, 1.8]
Family Income	<i>ref</i>	<i>ref</i>	<i>ref</i>	<i>ref</i>	<i>ref</i>
\$0–49,999	1.1 [0.5, 2.3]	1.0 [0.3, 3.4]	2.2 [0.591, 8.165]	1.0 [0.3, 2.9]	1.1 [0.5, 2.4]
\$50,000+					
Parental Education Level					
12 or less years	1.5 [0.6, 3.6]	1.5 [0.4, 5.0]	1.3 [0.2, 6.9]	1.2 [0.4, 4.0]	1.5 [0.6, 3.5]
12 to 15 years	1.7 [0.7, 4.2]	3.5 [0.8, 15.5]	1.1 [0.3, 4.3]	1.5 [0.5, 4.2]	1.7 [0.7, 4.1]

<i>Independent Variables</i>	<i>Adjusted Associations</i>				
	(1) ^a	(2) ^b	(3) ^c	(4) ^d	(5) ^e
16 or more years	ref	ref	ref	ref	ref
Race/Ethnicity					
White, non-Hispanic	ref	ref	ref	ref	ref
Black, non-Hispanic	0.7 [0.3, 1.6]	1.2 [0.3, 4.2]	1.3 [0.3, 5.1]	0.7 [0.2, 2.1]	0.7 [0.3, 1.6]
Hispanic	0.8 [0.3, 2.0]	2.9 [0.7, 11.4]	0.3 [0.1, 1.1]	0.7 [0.2, 2.6]	0.8 [0.3, 2.1]
Other, non-Hispanic	0.4* [0.2, 0.8]	0.9 [0.2, 4.3]	0.3* [0.1, 0.9]	0.5 [0.2, 1.5]	0.4* [0.2, 0.8]
R-Squared	0.0304	0.0511	0.0779	0.0250	0.0308

Robust standard errors in parentheses

**
p<0.01,

*
p<0.05

^t conditional on any use of each, so for PT models, conditional on any PT use [PT]

^a adjusted for EI service duration, total per child EI intensity, and child and family characteristics listed above in (1)

^b adjusted for EI service duration, total per child EI PT intensity, and child and family characteristics listed above in (1), and conditional on any PT use

^c adjusted for EI service duration, total per child EI OT intensity, and child and family characteristics listed above in (1), and conditional on any OT use

^d adjusted for EI service duration, total per child EI ST intensity, and child and family characteristics listed above in (1), and conditional on any ST use

^e adjusted for EI service duration, total per child EI intensity, count of EI Providers, and child and family characteristics listed above in (1).