ERDC
Education Research & Data Center

Health Factors in Education Outcomes of Children in Need of Early Intervention Services:

Connecting Medical and Early Learning Data in Washington State

Education Research and Data Center
Forecasting and Research
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About the ERDC

The research presented here uses data from the Education Research and Data Center, located in the Washington Office of Financial Management. ERDC works with partner agencies to conduct powerful analyses of learning that can help inform the decision-making of Washington legislators, parents, and education providers. ERDC's data system is a statewide longitudinal data system that includes de-identified data about people's preschool, educational and workforce experiences.

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Executive Summary

This ERDC report explores how health factors are associated with children's early learning outcomes. We focused on a cohort of Washington state children between zero to three years old who participated in the Washington State Early Support for Infants and Toddlers (ESIT) program and have claims record(s) in Washington State All Payer Claims Database (APCD). The results specify the medical diagnoses early learners receive and connects this to their education experience, specifically kindergarten readiness assessment scores and special education enrollment.

The analyses showed that boys, children with a longer duration of services, and children diagnosed with autism, cerebral palsy, Down syndrome, epilepsy, and microcephaly experienced higher rates of special education enrollment and lower kindergarten readiness scores. We concluded that connecting healthcare and education data provides the possibility to identify children with certain medical conditions in need of intervention evaluations and services in addition to medical treatments.

Introduction

The first years of life are critical for children's physical, language, and social emotional development.[1] [2] A child's health directly affects their learning ability and long-term education outcomes.[3] Not only is the provision of early learning services to vulnerable children and their families of substantial economic and social importance, adequate medical insurance coverage and access to health services are also essential in children's development and learning. Many studies have focused on the health benefits of education as results from better social economic status and health behaviors.[4] [5] [6] However, the reverse effects of health conditions, disabilities, and unhealthy behaviors on education outcomes have not received equivalent attention.[7] By combining early learning education data with medical claims data, this report explored health conditions on education outcomes, specifically for children in need of early intervention services.

This report was preceded by three ERDC reports[8] [9] [10] that profiled Washington State Early Support for Infants and Toddlers (ESIT) participants, tracked their early learning pathways, and applied Washington State All Payer Claims Database (APCD) data to identify underserved populations. In this series of studies, we captured the growing trends of participation in the ESIT

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[1] Guralnick, M. (2008). International Perspectives on Early Intervention: A Search for Common Ground, *Journal of Early Intervention*. 30(2): 90-101.

[2] Heckman, J. (2006). Skill Formation and the Economics of Investing in Disadvantaged Children. *Science*, 312: 1900-1902

[3] Michael, S. L., Merlo, C. L., Basch, C. E., Wentzel, K. R. and Wechsler, H. (2015). Critical Connections: Health and Academics. *Journal of School Health,* 85: 740–758.

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[7] Children's Health Fund. (2017). Health barriers to learning: the prevalence and educational consequences in disadvantaged children: a review of the literature.

[8] Zhao, H. Who Receives Early Intervention Services in Washington State? An Analysis of Early Support for Infants and Toddlers Program Administrative Data https://erdc.wa.gov/publications/early-childhood-education/who-receives-early-intervention-services-washington-state

[9] Zhao, H. Identifying Children in Need for Early Intervention Services in Washington State. An Application of Washington State All Payer Claims Database in Education Research https://erdc.wa.gov/publications/early-childhood-education/identifying-children-need-early-intervention-services

[10] Zhao, H. Early Learning Pathways of Early Intervention Service Participants in Washington State. What are the early learning pathways of former ESIT program participants? https://erdc.wa.gov/publications/early-childhood-education/early-learning-pathways-early-intervention-service

program over time and described the critical steps children go through in the ESIT program, including referral, evaluation, service plan development and review, as well as outcome and transition out of the program. We also showed that a vast majority of ESIT participants receive public school-based special education services after they exit ESIT. We then examined the value of combining ESIT data with medical claims information to possibly identify more opportunities of serving children in need for early interventions.

In this report, we build on prior work to focus on a cohort of Washington state children between birth to three years old who participated in Washington's ESIT program and have claims record(s) in the Washington APCD. This study specified the medical diagnoses early learners receive and tracked their educational outcomes in relation to the medical conditions they experience. Specifically, this study addressed the following questions:

- **What medical diagnoses did this cohort of early learners receive?**
- **What were the kindergarten readiness scores and special education enrollment for this cohort of early learners?**

Data Sources

Washington's ESIT database documents demographic characteristics, eligibility reason, services received, and outcomes of recipients. The ESIT program[11] provides early intervention services to children birth to three who have disabilities or developmental delays. The main purposes of the ESIT program are: 1) finding eligible children and screening, tracking, monitoring, and providing referral services; and 2) providing early intervention services, including developmental and therapeutic services for children who are identified as developmentally delayed or have an established condition for delay.

Washington State All Payer Claims Database (APCD)[12] is a large-scale database that collects health care claims data from payer sources including Medicaid, private insurers, and Medicare plans. APCD includes individual characteristics, claim diagnoses, procedures, and

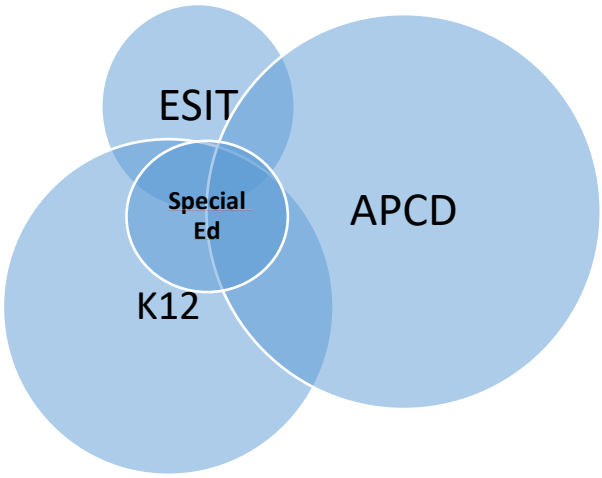
[11] https://www.dcyf.wa.gov/services/child-development-supports/esit
[12] https://www.hca.wa.gov/about-hca/washington-state-all-payer-claims-database-wa-apcd

payment information. It reached full operation in 2018 and is a tool to investigate healthcare use and to promote cost transparency. Combining ESIT and APCD provides a unique opportunity to better understand the potential scope of interventions ESIT could provide, and track healthcare services early learners receive.

WAKids assessment data is collected by the Washington State Office of Superintendent of Public Instruction (OSPI) [13]. It contains assessment results designed to determine "kindergarten readiness", or whether children exhibit the common characteristics of children entering kindergarten. Kindergarten teachers evaluate children's readiness by observing them during everyday classroom activities in six areas: social-emotional, physical, cognitive, language, literacy, and mathematics. Another education outcome studied in this report is school based special education enrollment in K-12 data[14], also collected by OSPI. We employed a flag indicating whether a child ever enrolled in special education or not.

Figure 1 is a conceptual diagram of the relations of the databases we used in this study. The intersect populations, ESIT children who had APCD records and either WAKIDs or special education records were the main interest in this study.

Figure 1: Conceptual diagram of relations of ESIT, APCD, K-12 and Special education databases



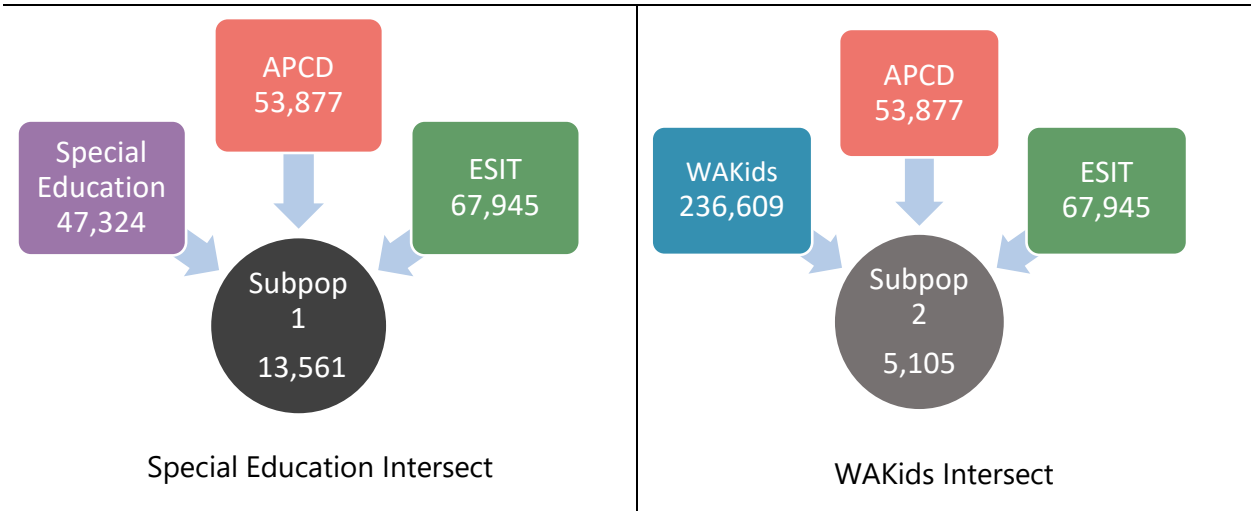
[13] https://www.k12.wa.us/student-success/testing/state-testing-overview/washington-kindergarten-inventory-developing-skills-wakids/wakids-whole-child-assessment
[14] https://www2.ed.gov/programs/osepeip/index.html

Using the Education Research & Data Center (ERDC) identity matching mechanism, we connected ESIT, APCD, WAKids, and special education records by assigning a cross-sector P20-ID to each child. We focused on two subpopulations in the studied time duration:

- *Special Education Intersect* (Subpopulation 1): Children who were in ESIT, with APCD claims records, and enrolled in special education programs
- *WAKids Intersect* (Subpopulation 2): Children who were in ESIT, with APCD claims records, and had WAKids kindergarten readiness scores

Figure 2 depicts the identity matching process to connect the multiple data sources. There were 978,152 children in the APCD data born between January 1, 2011 and December 31, 2018. Of these, 385,144 were successfully matched with a P20-ID (unmatched ones are either not reaching age of K12 or not in public schools of Washington). 53,877 had our interested medical conditions from APCD recorded diagnoses. For the ESIT data, there were 67,945 children in ESIT who had a specific referral date, first Individualized Family Service Plan (IFSP) created date, and transition out date documented. Finally, there were 47,324 matched records for special education enrollment and 236,609 matched records for WAKids. Subpopulation 1 The Special Education Intersect (Subpopulation 1) had 13,561 records. The WAKids Intersect (Subpopulation 2) had 5,105 records.

Figure 2: Identity matching results of APCD and ESIT databases intersected with special education and WAKids data



Children referred to ESIT are evaluated to determine their eligibility. With eligibility established, an initial Individualized Family Service Plan (IFSP) is developed for the child and family. IFSPs are revisited at least each year. Current ESIT participants all have their IFSPs active until transitioning out of program due to various reasons such as reaching age limit, no longer being eligible or moving out of state. Eligible three to five years old children have the options to enroll in Early Childhood Education and Assistance Program (ECEAP), Head Start, school based or other programs. Once students reach the K12 system, they might attend school-based services if necessary.

Analytical Approaches

This study took two different analytical approaches. First, descriptive analyses provide an introductory view of the data for children in the ESIT and APCD databases. Second, this study aimed to determine how medical conditions affect a child's education outcomes.

For the statistical analysis, we applied a logistic regression model to analyze factors determining the education outcomes of ESIT children regarding their characteristics and different physical, cognitive or behavioral conditions. Logistic regression is an analytical tool to describe data and examine the relationship between dichotomous dependent variable and independent variables. For example, within the ESIT data, kindergarten readiness pass rates or special education enrollment depends on how many months of services a student received, their gender, medical diagnoses, and other variables. We hoped to find if any medical conditions are more commonly associated with a child's education achievement in the early learning stage and, together with early intervention services and medical treatments they receive. For more details about the design of the logistic regression technique, see Appendix B.

Findings

Descriptive Analysis

The number of children referred to and receiving services from ESIT is increasing over time. Table 1 displays the summaries of the count of children in ESIT administrative data, from 2010 to 2019, in number of referrals received, initial IFSP created, having active IFSPs and transitioning out. Key findings include:

- ESIT received 22,597 referrals in 2019, a dramatic increase from 5,844 in 2010.
- Less than half (46.7%) of the referred children in 2019 had their initial IFSP created. This number was 78.9% in 2010.
- By 2019, 10,345 children transitioned out of the program and 17,440 children had active IFSPs served by ESIT program.

Table 1: Count of children in ESIT administrative data by important milestones

	ESIT Program Counts of Children			
Year	Referrals Received	First IFSP Created	Active IFSP	Transitioned Out*
2010	5,844	4,613	6,254	1313
2011	7,175	5,623	9,232	5,860
2012	10,038	6,033	10,015	5,724
2013	11,485	6,293	10,671	6,237
2014	13,549	6,799	11,280	6,514
2015	15,673	7,538	12,380	7,190
2016	16,923	7,906	13,294	7,980
2017	18,872	8,674	14,301	8,543
2018	21,236	10,086	16,222	9,358
2019	22,597	10,560	17,440	10,345

*Note: First IFSP created date defines the starting date of a child receiving services while transition date defines the end of services; number of active IFSPs (from different children) indicates how many children are active in ESIT; *Count of transitioned outs are number of children who have documented transition date and reason in the administrative data.*

The growth of the ESIT program suggests a demand for early intervention services in Washington State. It raises an important question about how we make sure all the eligible children are referred to the program and how Washington can extend the opportunity of services to these children in need.

Our analysis suggests there is a difference between the number of ESIT enrolled children and APCD reported children with the same medical conditions. This study explored the application of APCD data as a tool to identify children possible in need for early learning services. Among ESIT children who were born between year 2011 and 2018, 14,508 children have diagnosed medical conditions documented. The ESIT program records fifty diagnosed conditions related to developmental delay and disability, such as autism, blood disorder, congenital anomaly, diabetes, Down syndrome, and severe injury (see Appendix A). The set of medical conditions we chose has International Classification of Diseases (ICD) codes explicitly defined and are among the most frequent medical conditions of ESIT children. In addition, these selected conditions covered fetal, chronic, mental conditions and disabilities. We mapped these ICD codes to APCD data and extracted medical claims with such diagnosis as the primary diagnosis or one of the first ten diagnoses of the claim.

Table 2 shows the counts of all the children documented with selected diagnosed medical conditions in ESIT data. As mentioned above, the selection was based on the availability of explicit ICD codes, frequency among ESIT records and relevance of interest of this report. Table 2 also reports counts of children in APCD data, born during the corresponding period, who filed medical claims related to this subset of conditions, including autism, cerebral palsy, Down syndrome, and others. Differences between the two databases emerge, for example:

- The ratio of children having cerebral palsy in ESIT to the counterpart in APCD data is 31.4%.
- There were a higher number of children diagnosed with Down syndrome in the ESIT database (989) compared to the APCD Claims (949).
- There is a significant difference between ESIT and APCD databases for children with nutritional deficiencies (0.3% match) and epilepsy (6.4% match).

Table 2: Count of children, born between January 1, 2011 and December 31, 2018, who have documented medical conditions in ESIT or have the primary diagnosis or one of the first ten diagnoses of the claim in APCD.

Selected Diagnosed Conditions	ESIT Children with Documented Diagnoses	APCD Children with Claim Diagnoses	Ratio of the Children with Diagnoses in ESIT to APCD*
Autism	1,073	2,260	47.5%
Cerebral Palsy	217	691	31.4%
Down Syndrome	989	949	104.2%
Epilepsy	133	2,089	6.4%
Fetal Alcohol Syndrome	28	171	16.4%
Hearing Loss	1,087	6,020	18.1%
Microcephaly	107	1,020	10.5%
Muscular Dystrophy	18	42	42.9%
Myelomeningocele	31	298	10.4%
Neurofibromatosis	22	131	16.8%
Nutritional Deficiency	15	4,426	0.3%
Spinal Bifida	108	312	34.6%
Visual Impairment	256	803	31.9%

*Note: * This ratio can be greater than 100% because currently, APCD does not include claims carried by self-insured employers, such as Boeing, Microsoft etc.*

There are several possible reasons for these differences including: 1) some children having these conditions were not severe enough for referral; 2) some were not eligible based on evaluation results; and/or 3) some families refused services. In addition, some children might either not be identified or referred to early intervention services.

We believe recognizing these differences could be a helpful tool in program planning and outreach to serve children and families in need. For example, it is possible to look at county level data. If a county has lower rate of ESIT acceptance out of APCD diagnoses, compared to other counties, it might be worth looking into availability of referral and evaluations. Therefore, individually linking APCD with education data, including ESIT children, could possibly provide additional opportunities to identify and serve children in need for early learning services.

Logistic Regression Analysis

Table 3 summarizes the counts and percentages of children with each medical condition. The left panel shows special education enrollment of children with each diagnosed medical condition whereas the right panel shows the rate of not being ready in each kindergarten readiness area. For example, there were 1,945 children diagnosed with autism, where 53.6% of them participated in special education at some point in their K12 study. Highlights from the analysis of this sample include:

- Over half of students with autism were enrolled in special education (53.6%). This was the highest percentage of special education enrollment across medical conditions.
- The most common medical diagnosis of interest was asthma (5,737 students). Within asthma patients, 23.8% enrolled in special education at some point of their K-12 education.
- Kindergarten readiness varied by medical condition and domain. Students diagnosed with Down syndrome had the lowest rate of Kindergarten readiness across all six domains.

Table 3: Counts of ESIT children who enrolled in special education or not being kindergarten ready by medical conditions.

	Special Education Enrollment		Areas of Not Being Kindergarten Ready						
Medical Conditions	Having this condition	Enrolled in Special Education	Have this condition	Math	Literacy	Cognitive	Language	Physical	Social Emotional
Asthma	5,737	23.8%	1,700	60.1%	47.2%	55.2%	54.1%	38.6%	50.7%
Autism	1,945	53.6%	712	65.2%	55.5%	78.7%	79.9%	60.3%	81.7%
Central Nervous System Deficit	21	14.3%	*	71.4%	28.6%	42.9%	57.1%	42.9%	14.3%
Cerebral Palsy	642	43.6%	205	74.1%	68.8%	75.6%	74.6%	73.7%	64.9%
Congenital Anomaly	5,254	26.3%	1,237	63.2%	53.0%	61.7%	61.0%	49.5%	55.9%
Cystic Fibrosis	652	29.4%	295	58.6%	50.8%	56.3%	54.2%	35.6%	47.5%
Down Syndrome	752	42.3%	196	93.9%	90.8%	94.9%	95.4%	86.7%	91.3%
Epilepsy	1,186	33.8%	288	80.6%	71.9%	77.4%	78.8%	69.8%	71.2%
Failure to Thrive	2,039	39.1%	860	60.7%	51.0%	59.7%	57.4%	43.6%	52.0%
Fetal Alcohol Syndrome	127	25.2%	47	51.1%	42.6%	55.3%	59.6%	29.8%	59.6%
Hearing Loss	3,230	32.7%	1,058	59.7%	50.2%	57.7%	60.4%	40.7%	51.7%
Microcephaly	633	35.9%	155	84.5%	74.2%	81.3%	80.6%	74.2%	75.5%
Muscular Dystrophy	35	48.6%	*	70.0%	30.0%	80.0%	60.0%	60.0%	50.0%
Myelomeningocele	176	33.0%	48	64.6%	47.9%	64.6%	52.1%	52.1%	43.8%
Neurofibromatosis	57	29.8%	21	85.7%	61.9%	85.7%	76.2%	42.9%	57.1%
Nutritional Deficiency	1,529	29.2%	451	57.2%	48.8%	56.5%	57.0%	43.7%	52.1%
Severe Injury	2,560	17.0%	371	64.2%	53.4%	58.0%	56.6%	42.6%	52.0%
Spina Bifida	195	30.3%	49	63.3%	49.0%	63.3%	51.0%	53.1%	42.9%
Visual Impairment	401	26.4%	55	78.2%	67.3%	69.1%	70.9%	60.0%	67.3%
Total	27,171	8,239	7,765	4,949	4,153	4,866	4,839	3,716	4,457

*Note: counts were based on the ESIT population born between 2011/01/01 and 2018/12/31 who also showed in APCD. The total counts of 27,171 in the left panel exceeded the size of this subpopulation 13,561 as one child could have multiple conditions in their medical history. Similarly, total number of 7,765 in the right panel exceeds population size of 5,105. * indicates that small cell was not reported.*

The regression reveals several trends related to different medical conditions and kindergarten readiness. Table 4 displays the model fitting estimates for kindergarten readiness. We simplified the results by showing the positive/negative signs of estimates with statistically significant p-values. We used the symbols (+/-) as signs of parameter estimates, where (+) indicates increased likelihood, while (–) indicates decreased likelihood. For example, the estimate for the autism parameter and math Kindergarten readiness was negative (-) with a p-value less than 0.01 (***). Students with autism were significantly less likely to be Kindergarten ready in math (and the other five domains).

Table 4: Logistic regression models of dichotomic outcomes depending on gender, service duration in month and medical conditions on ESIT/WAKids/APCD intersect

	Being Ready in Areas of Kindergarten Readiness											
	Math		Literacy		Cognitive		Language		Physical		Social Emotional	
Parameter	*Est.*	*p*	*Est.*	*p*	*Est.*	*p*	*Est.*	*p*	*Est.*	*p*	*Est.*	*p*
Intercept	+	***	+	***	+	***	+	***	+	***	+	***
Gender (Female)	-	*			+	***	+	**	+	**	+	***
Service Duration (in Months)	-	*	-	**	-	*	-	**	-	***	-	***
Asthma	-	**										
Autism	-	***	-	***	-	***	-	***	-	***	-	***
Cerebral Palsy	-	**	-	**	-	**	-	**	-	***	-	**
Down Syndrome	-	***	-	***	-	***	-	***	-	***	-	***
Epilepsy	-	***	-	***	-	***	-	***	-	***	-	***
Fetal Alcohol Synd.									+	*		
Hearing Loss							-	**				
Microcephaly	-	***	-	***	-	***	-	***	-	***	-	***
Muscular Dystrophy												
Myelomeningocele												
Neurofibromatosis	-	**			-	**	-	**				
Nutritional Deficiency												
Spina Bifida												
Visual Impairment	-	*										

*Note: +/- are signs of parameter estimates, where + indicates increased likelihood while – indicates decreased likelihood. *** denotes P-values less than 0.01; ** denotes P-values less than 0.05; * denotes P-values less than 0.10; Blank cells indicate a lack of significant results. No significant multicollinearity was detected in VIF test.*

The regression also reveals several trends related to different medical conditions and special education enrollment. Table 5 displays the model fitting estimates for special education enrollment. We again simplified the results by showing the positive/negative signs of estimates with statistically significant p-values, by using (+/-) as signs of parameter estimates, where (+) indicates increased likelihood, and (–) indicates decreased likelihood. For instance, the estimate for the autism parameter and special education enrollment was positive (+) with a p-value less than 0.01 (***). This indicates that students with autism were significantly more likely to enroll in special education.

Table 5: Logistic regression models of dichotomic outcomes depending on gender, service duration in month and medical conditions on ESIT/Special Education/APCD intersect

	Special Education Enrollment	
Parameter	*Estimate (+/-)*	*p*
Intercept	+	***
Gender (Female)	-	***
Service Duration (in Months)	+	***
Asthma		
Autism	+	***
Cerebral Palsy	+	***
Down Syndrome	+	***
Epilepsy	+	**
Fetal Alcohol Synd.		
Hearing Loss	+	***
Microcephaly	+	**
Muscular Dystrophy	+	**
Myelomeningocele		
Neurofibromatosis		
Nutritional Deficiency		
Spina Bifida		
Visual Impairment	+	**

*Note: +/- are signs of parameter estimates, where + indicates increased likelihood while – indicates decreased likelihood. *** denotes P-values less than 0.01; ** denotes P-values less than 0.05; * denotes P-values less than 0.10; Blank cells indicate a lack of significant results. No significant multicollinearity was detected in VIF test.*

The results in Tables 4 and 5 offer insight into the association of medical conditions with either Kindergarten readiness or special education enrollment. Below are key observations from the tables.

Kindergarten Readiness

- **Boys** in this cohort have a higher likelihood of not being Kindergarten ready in four of the six domains: cognitive, language, physical, and social emotional.
- Students with a **longer duration of service in months** were less likely to be kindergarten ready.
- Students diagnosed with **Autism, cerebral palsy, Down syndrome, epilepsy, and microcephaly** had a decreased likelihood of being kindergarten ready across all six domains.
- **Myelomeningocele and nutritional deficiency** were not significant in any area of kindergarten readiness.

Special Education Enrollment

- **Boys** in this cohort have a higher likelihood of enrolling in special education.
- Students with a **longer duration of service in months** were more likely to participate in special education.
- Being diagnosed with **autism, cerebral palsy, Down syndrome, epilepsy, hearing loss, microcephaly, muscular dystrophy, or visual impairment** was associated with an increased likelihood of a child enrolling in special education.
- Being diagnosed with **asthma, neurofibromatosis, or spina bifida** did not impact the likelihood of special education enrollment.
- **Myelomeningocele and nutritional deficiency** were not significant in special education enrollment.

Altogether, this analysis helps us to better understand the relationship of specific medical conditions to ESIT children's education outcomes. Our goal is not to determine causality but to

explore the value of connecting medical conditions with education outcomes to identify more opportunities serving children in need for interventions. We acknowledge some medical conditions cannot be reversed or alleviated, but some conditions may be addressed through environmental and educational factors. Therefore, it is valuable to understand and explore these trends.

Conclusion

The first years of life build the foundation for life-long health and wellness and educational achievement. A child's health directly affects their ability to learn, and education attainment in turn impacts long term health. Adequate medical insurance coverage and access to healthcare are especially essential for positive outcomes in education and health for vulnerable early leaners.

This report explored the relationship of health conditions and disabilities of ESIT early learners to K12 special education enrollment and Kindergarten readiness assessments. We integrated ESIT, APCD, special education and WAKids data to identify the characteristics of the intersecting population. We tracked their education outcomes and explored medical conditions of interest. We concluded that among ESIT participants, those diagnosed with autism, cerebral palsy, Down syndrome, epilepsy, and microcephaly experienced a higher likelihood of special education enrollment and a lower likelihood of being ready for kindergarten. Connecting healthcare and education data provided a possibility to identify children with certain medical conditions in need for intervention evaluations and services.[15] [16]

The application of medical data in education research provides a unique opportunity for aligning and coordinating early childhood health and early learning systems to establish a solid foundation for school-readiness for all children, especially groups in need.[17] As this was an

[15] Case A, et al. (2005). The lasting impact of childhood health and circumstance. *Journal of Health Economics*, 24:365-89

[16] Barbaresi, W. J., Katusic, S. K., Colligan, R. C., Weaver, A. L., & Jacobsen, S. J. (2007). Long-term school outcomes for children with attention-deficit/hyperactivity disorder: a population-based perspective. *Journal of developmental and behavioral pediatrics: JDBP*, *28*(4), 265–273

[17] Policy Statement to Support the Alignment of Health and Early Learning Systems (PDF) (ed.gov)

exploratory report, there are several possibilities to extend beyond the scope of this study. We can incorporate more details from education and medical data, such as number of medical claims, most frequent medical procedures, cost associated with claims, special education starting age, total educational services dosage, and kindergarten readiness raw scores. We may also include demographic data related to race/ethnicity, geographic location, primary language, parent education level, Medicaid eligibility reason, eligibility length, early learning service eligibility, progress stage, and transition pathway if relevant data become available. Further studies could also take into consideration the combination of number of claims a child has and the cost associated with claims to calibrate the actual severity levels. We may also use multivariate studies such as principle components or factor analysis to refine these quantitative models for higher power of extrapolation.

Appendix A: Diagnosis Codes

ICD-9 diagnosis codes (effective before 10/01/2015) and ICD-10 diagnosis codes (effective from 10/01/2015) of interested medical conditions

Disease	ICD-10	ICD-9
Autism	F84.0	299.00, 299.01
Central Nervous System Deficit	C72	192.0, 192.2
Cerebral Palsy	G80.0, G80.1, G80.2, G80.3, G80.4, G80.8, G80.9	333.71, 343.1, 343.3, 343.4, 343.8, 343.9, 343.0
Cystic Fibrosis	E84	277.09, 277.00, 277.01, 277.02, 277.03
Down Syndrome	Q90	758.0
Epilepsy	G40.001, G40.009, G40.011, G40.019, G40.109, G40.111, G40.119,G40.301, G40.309,G40.801, G40.802,G40.803, G40.804, G40.821, G40.822, G40.823, G40.824, G40.901, G40.909 ,G40.911, G40.919, G40.A11, G40.A19, G40.B01, G40.B09, G40.B11, G40.B19	345.01, 345.10, 345.2, 345.3, 345.50, 345.51, 345.60, 345.61, 345.70, 345.71, 345.80, 345.81, 345.90, 345.91
Fetal Alcohol Syndrome	Q86.0	760.71
Hearing Loss	H90.0, H90.2, H90.3, H90.5, H90.11, H90.12, H90.41, H90.42, H91.01, H91.02, H91.03, H91.09, H91.8X1, H91.8X2, H91.8X3, H91.8X9	388.11, 389.00, 389.01, 389.02, 389.03, 389.04, 389.05, 389.06, 389.08, 389.10, 389.11, 389.12, 389.13, 389.14, 389.15, 389.16, 389.17, 389.18, 389.8
Microcephaly	Q02	742.1
Muscular Dystrophy	G71.0, G71.11	359.21
Myelomeningocele	Q05.1, Q05.2, Q05.6, Q05.7, Q05.8, Q05.9	741.00, 741.02, 741.03, 741.90, 741.92, 741.93
Neurofibromatosis	Q85.01, Q85.09	237.71, 237.79
Nutritional Deficiency	E50, E51, E52, E53, E54, E55, E56, E58, E59,E60, E61, E63, E64	269.8, 263.9, 264.0, 264.2, 264.3, 264.4, 264.5, 264.6, 264.7, 264.8, 264.9, 265.0, 265.1, 265.2, 266.0, 266.1, 266.2, 266.9, 267, 268.1, 268.9, 269.0, 269.1, 269.2, 269.3, 269.9
Spinal Bifida	Q05.8, Q05.9, Q07.00, Q07.01, Q07.03	741.00, 741.90
Visual Impairment	H54	369.15, 369.00, 369.01, 369.03, 369.04, 369.06, 369.07, 369.11

Appendix B: Technical Notes

Details on Logistic Regression

With the aim to determine how medical conditions affect a child's education outcomes, we applied a logistic regression model to analyze factors determining the education outcomes of ESIT children regarding their characteristics and different physical, cognitive or behavioral conditions. For example, with ESIT data, the logit η of kindergarten readiness or special education depends on how many months of services a student received, gender, medical diagnoses, binary variables denoted by Zs. We focused on the binary results of whether a child ever enrolled in special education, and binary results of whether a child not being ready in any areas of kindergarten readiness evaluation, respectively. We took into consideration their gender, duration of ESIT services received, and the presence of interested medical conditions. The duration of ESIT services were calculated by the time difference between the date of first IFSP created (start of service) and final transition out date from ESIT (end date of service). This was an imperfect calculation because there is a possibility of intermittent services.

We hoped to find if any medical conditions are more influential than the others in determining a child's education achievement in the early learning stage and, together with early intervention services and medical treatments they receive.

$$
\begin{aligned}
logit\{\Pr(Y=1|x)\} &= log\left\{\frac{\Pr(Y=1|x)}{1-\Pr(Y=1|x)}\right\} \\
&= \alpha + \beta_1 Duration\ of\ Services\ in\ months + b_0 + b_1 Z_{Gender} + b_1 Z_{Asthma} \\
&+ b_2 Z_{Autism} + b_3 Z_{CerebralPalsy} + b_4 Z_{Down} + b_5 Z_{Epilepsy} + b_6 Z_{FetalAlcoholSynd} \\
&+ b_7 Z_{Hearing} + b_8 Z_{Microcephaly} + b_9 Z_{MuscularDystrophy} + b_{10} Z_{Myelomeningocele} \\
&+ b_{11} Z_{Neurofibromatosis} + b_{12} Z_{NutritionalDefici} + b_{13} Z_{SpinaBifida} \\
&+ b_{14} Z_{VisualImpairment}
\end{aligned}
$$

$$
where\ Y = 1\ is\ Yes\ for\ enrollment\ in\ special\ education\ or\ being\ ready\ in\ any\ areas\ of\ kindegaren\ readiness\ assessments
$$