

Effectiveness of the National Health Screening Program for Detecting Neurodevelopmental Disorders

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Objective

This study aimed to evaluate the effectiveness of the National Health Screening Program for Infants and Children (NHSPIC) in detecting neurodevelopmental disorders using South Korea's National Health Insurance Database (NHID).

Methods

We conducted a study involving children born between 2011 and 2018 and followed them through 2022 using NHID data. We included children who underwent every health screening from the 2nd to the 4th stages of NHSPIC. Based on NHSPIC results, cases reported as ‘recommendation for further evaluation’ were categorized into the ‘abnormal group’, and cases with ‘appropriate’ results were classified as the ‘normal group’. Propensity score matching (1:3 ratio) balanced demographic factors, including birth year, sex, residential area, income level defined by insurance premium percentile, birth weight, and prematurity. The analysis focused on post-NHSPIC abnormal findings for neurodevelopmental disorders in the abnormal group, excluding pre-existing diagnoses. We included diagnoses in the normal group after matching the index date, defined as the date of receiving abnormal findings in the abnormal group. Logistic regression compared the incidence rates for eight neurodevelopmental disorders: cerebral palsy (CP), intellectual disability (ID), developmental coordination disorder (DCD), autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), tic disorders, developmental language disorder (DLD), and learning disabilities (LD).

Results

Among the 3,181,991 children born between 2011 and 2018, we included 1,623,927 cases that underwent every NHSPIC screening from 12 to 36 months(Table 1). Of these, 1,564,038 individuals were classified as the ‘normal group’, while 59,889 formed the ‘abnormal group’. After propensity score matching, our analysis included 179,667 individuals in the ‘normal group’ and 59,889 in the ‘abnormal group’(Table 2). Demographic factors did not show statistically significant differences after propensity score matching. Our comparative analysis consistently revealed higher odds ratios for disease occurrence in the abnormal group, particularly for CP (Odds Ratio [OR], 10.75; 95% confidence interval [CI], 8.97-12.88), ID (OR 11.65; 95% CI 10.56-12.85), DCD (OR 11.03; 95% CI 7.55-16.11), ASD (OR 10.82; 95% CI 10.07-11.62), and DLD (OR 8.23; 95% CI 7.75-8.75)(Figure 1). We also observed relatively low OR of 3.27 (95% CI: 2.45-4.36) for LD, and 3.15 (95% CI: 3.00-3.30) for ADHD. Tic disorders had the lowest odds ratio among the neurodevelopmental disorders (OR 1.61; 95% CI 1.47-1.77).

Table 1. Demographic Characteristics of Normal and Abnormal Groups Before Propensity Score Matching

Demographic factor		Normal group		Abnormal group		P-value
		N	(%)	N	(%)	
Total		1,564,038		59,889		
Birth year	2011	146,627	9.4	3,468	5.8	<.0001
	2012	183,637	11.7	5,625	9.4	
	2013	184,902	11.8	5,903	9.9	
	2014	197,496	12.6	8,080	13.5	
	2015	223,961	14.3	9,035	15.1	
	2016	218,644	14.0	9,609	16.0	
	2017	211,268	13.5	9,094	15.2	
	2018	197,503	12.6	9,075	15.2	
Sex	Male	796,710	50.9	39,712	66.3	<.0001
	Female	767,328	49.1	20,177	33.7	
Residential area	Seoul	300,098	19.2	11,351	19.0	<.0001
	Metropolitan cities	401,405	25.7	16,138	26.9	
	Others	862,535	55.1	32,400	54.1	
Income group	First (lowest)	2,758	0.2	239	0.4	<.0001
	Second	144,168	9.2	5,975	10.0	
	Third (middle)	299,761	19.2	12,225	20.4	
	Fourth	658,024	42.1	25,122	41.9	
	Fifth (highest)	459,327	29.4	16,328	27.3	
Birth weight	<1.5kg	3,406	0.2	488	0.8	<.0001
	1.5-2.5kg	70,346	4.5	4,528	7.6	
	2.5-3.5kg	1,081,928	69.2	40,248	67.2	
	≥3.5kg	408,358	26.1	14,625	24.4	
Prematurity	Yes	60,587	3.9	4,349	7.3	<.0001
	No	1,503,451	96.1	55,540	92.7	

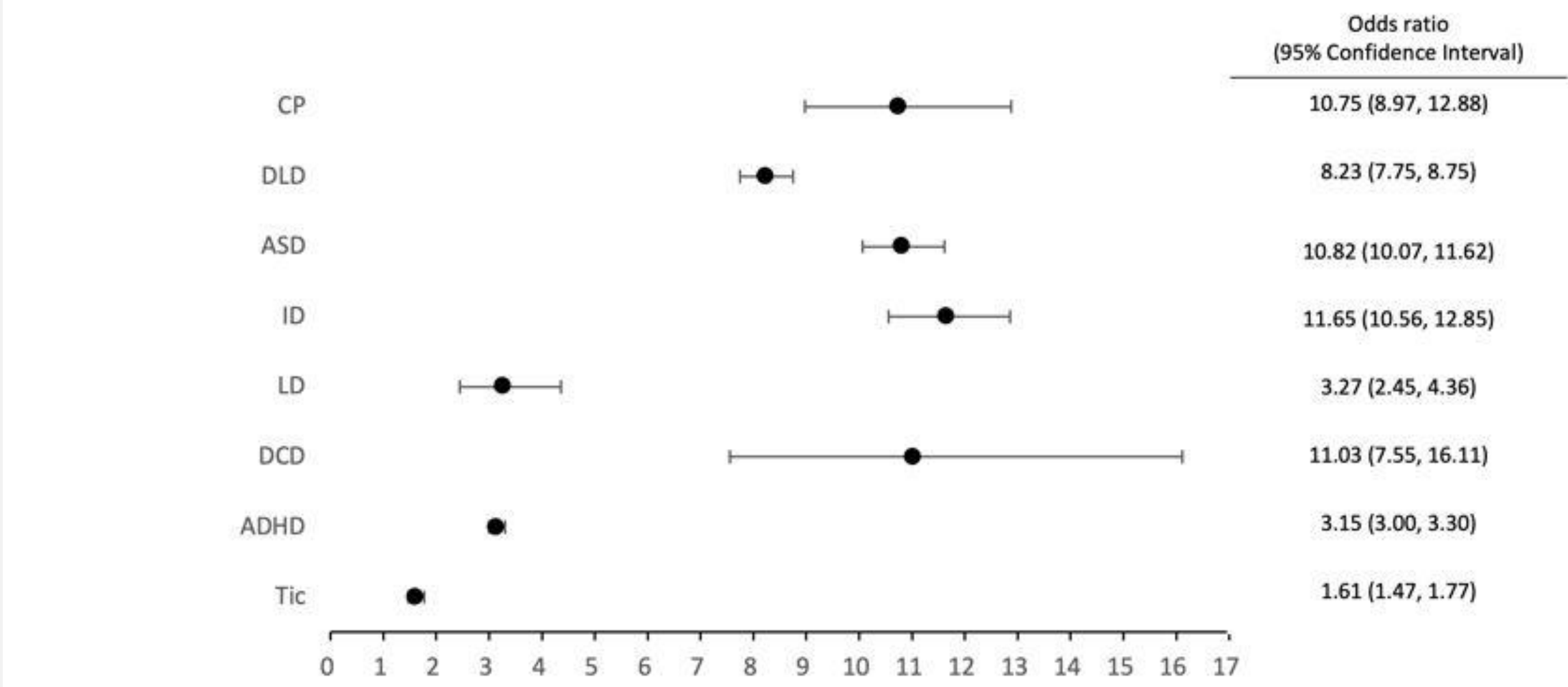


Table 2. Demographic Characteristics of Normal and Abnormal Groups After Propensity Score Matching

Demographic factor		Normal group		Abnormal group		P-value
		N	(%)	N	(%)	
Total		179,667		59,889		
Birth year	2011	10,391	5.8	3,468	5.8	1.0000
	2012	16,901	9.4	5,625	9.4	
	2013	17,705	9.9	5,903	9.9	
	2014	24,229	13.5	8,080	13.5	
	2015	27,090	15.1	9,035	15.1	
	2016	28,822	16.0	9,609	16.0	
	2017	27,291	15.2	9,094	15.2	
	2018	27,238	15.2	9,075	15.2	
Sex	Male	119,161	66.3	39,712	66.3	0.9502
	Female	60,506	33.7	20,177	33.7	
	Seoul	34,037	18.9	11,351	19.0	
Residential area	Metropolitan cities	48,386	26.9	16,138	26.9	0.9946
	Others	97,244	54.1	32,400	54.1	
Income group	First (lowest)	701	0.4	239	0.4	0.9989
	Second	17,917	10.0	5,975	10.0	
	Third (middle)	36,686	20.4	12,225	20.4	
	Fourth	75,354	41.9	25,122	41.9	
	Fifth (highest)	49,009	27.3	16,328	27.3	
Birth weight	<1.5kg	1,455	0.8	488	0.8	0.9972
	1.5-2.5kg	13,626	7.6	4,528	7.6	
	2.5-3.5kg	120,724	67.2	40,248	67.2	
	≥3.5kg	43,862	24.4	14,625	24.4	
Prematurity	Yes	13,014	7.2	4,349	7.3	0.8807
	No	166,653	92.8	55,540	92.7	

Figure 1. Forest Plot of Odds Ratios and Confidence Intervals for Eight Neurodevelopmental Disorders,

Abbreviations: CP, cerebral palsy, ID, intellectual disability, DCD, developmental coordination disorder ASD, autism spectrum disorder, ADHD, attention deficit hyperactivity disorder, Tic, tic disorders, DLD, developmental language disorder, LD, learning disabilities

Conclusion

For the detection of neurodevelopmental disorders, NHSPIC has demonstrated effectiveness by highlighting significant differences in diagnostic rates between abnormal and normal groups. This underscores its potential for early detection and intervention. To enhance the efficiency of diagnosing neurodevelopmental disorders such as LD, ADHD, and Tic Disorders, there is a need to further develop survey items within the NHSPIC.