ASSESSING THE ROLE OF HEARING IMPAIRMENTS AND SOCIOECONOMIC DISPARITITES IN GRADE RETENTION DURING THE COVID-19 ERA

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ABSTRACT

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This study investigates the predictors of grade retention among school-aged children, with a focus on the role of hearing impairments, socioeconomic status, and demographic factors, as well as the impact of the COVID-19 pandemic. Using data from the National Survey of Children's Health (NSCH) 2017-2022, logistic regression models were employed to analyze the effects of these variables. Significant predictors of grade retention were identified, including hearing impairments (OR = 2.20, $p < 0.001$), older age (12-17 years, OR = 1.67, $p < 0.001$), and lower income levels. In addition, females were found to have lower odds of retention compared to males (OR = 0.70, $p < 0.001$). The COVID-19 period was associated with a decrease in retention likelihood (OR = 0.78, $p < 0.01$), suggesting policy changes during the pandemic may have influenced educational outcomes. The study concludes that while the pandemic influenced overall retention rates, comprehensive policies and targeted support are needed to address the systemic factors contributing to grade retention.

Introduction

Research in educational psychology has repeatedly shown that grade retention, or repeating a grade, is influenced by a variety of factors such as socioeconomic status, race, age, gender, and physical challenges such as hearing impairments. Children with hearing difficulties frequently encounter major educational obstacles, which can result in poorer academic outcomes than their peers who do not have hearing issues. These challenges may stem from difficulties in communication, limited access to resources, and social isolation, among other reasons. According to the World Health Organization (WHO), hearing loss in children can impede language development, reduce educational attainment, and hinder overall cognitive growth. Previous studies have demonstrated that early intervention and appropriate educational support are crucial for minimizing these impacts (Moeller, 2000; Lieu, 2013).

Regardless of the degree, children with hearing difficulties often require tailored learning environments to succeed academically. Many educational systems face challenges in delivering adequate support due to resource limitations, a shortage of trained staff, and insufficient awareness among educators. These limitations can contribute to higher rates of school retention, where students are required to repeat a grade to improve their academic standing. Jimerson et al. (2002) and Skiba et al. (2016) have highlighted that retention disproportionately affects children from marginalized backgrounds, including those with disabilities.

The COVID-19 pandemic introduced unprecedented disruptions to educational institutions, prompting questions about its impact on retention rates and the interaction between established predictors and the post-pandemic environment. Children with hearing impairments may have been particularly vulnerable during this period due to the challenges of remote learning. Online education can rely heavily on auditory information, and many platforms were

not designed with accommodations for students with hearing difficulties. This lack of accessibility, combined with reduced opportunities for individualized support and specialized services, likely exacerbated existing challenges for these students.

Previous studies have shown that the pandemic's effects on education were not uniform. Some groups of students experienced heightened disparities due to reduced resources and support networks (van Lancker & Parolin, 2020). For children with hearing impairments, the transition to remote or hybrid learning environments may have further limited their participation and engagement, leading to concerns about increased retention rates. Despite the extensive disruptions caused by COVID-19, there is currently a gap in research focused on how the pandemic modified the impact of hearing problems and other factors on school retention, and this study aims to address this gap.

Methods

The present study utilized data from the National Survey of Children's Health (NSCH). The NSCH employs a complex sampling design to ensure a nationally representative sample of children across the United States. The survey uses a multistage probability sampling method designed to collect data on the physical, mental, and emotional health of children aged 0 to 17 years, as well as their families. The sample is drawn from households that are selected through address-based sampling (ABS) frames, which include both urban and rural areas to capture a broad demographic and geographic representation. From these selected households, parents or guardians are asked to complete detailed questionnaires about one randomly chosen child per

household. This approach helps minimize selection bias and ensures that the collected data reflects the diversity of the U.S. population.

In this analysis, datasets from 2017 to 2022 were used to investigate predictors of school retention, the dependent variable. The independent variables included income based on federal poverty levels, race, age group, sex, hearing impairments, ethnicity, and a binary variable indicating whether the data was collected before or after COVID-19. Logistic regression models were used to evaluate the main effects of these predictors and interaction terms involving the COVID period variable to determine whether the pandemic altered the relationship between predictors and retention.

To ensure more comparable group sizes between children with and without hearing difficulties, a random sample of 5 percent of the group without hearing difficulties was selected. This sampling approach was implemented to maintain a manageable dataset size while allowing for balanced analysis between the groups. The final dataset consisted of approximately 9,300 children, with a balanced representation of sex (53% male and 47% female). Around 5.3% of the children in the sample were reported to have hearing difficulties or deafness. The sample was nearly evenly split between data collected pre- and post-COVID-19, allowing for analysis of pandemic-related effects on school retention. The inclusion of multiple demographic variables, such as race, gender, income, and ethnicity, ensured a comprehensive examination of factors influencing educational outcomes.

Logistic regression makes several key assumptions that were evaluated in this study to ensure the robustness of the analysis. The first assumption is that the dependent variable should be binary, which was met as the outcome variable (school retention) was coded as a binary variable. The second assumption is the independence of observations, which was upheld by

ensuring that each case represented a unique child without repeated measures. Multicollinearity was assessed using VIF values, with all predictors showing values well below 10, indicating that multicollinearity was low (see Appendix A Table A1). Linearity of the logit for continuous variables was not a concern as all variables included were categorical. Additionally, outliers were examined, and no influential cases were identified that would impact the model's results. Lastly, the model fit was assessed using the Hosmer-Lemeshow test, which indicated an acceptable fit, suggesting that logistic regression was appropriate for this analysis (see Appendix A Table A2).

Results

Tables 1 and 2 depict the frequency counts for the variables used in the analysis.

Table 1: Grade Retention Variable Frequency Counts by Age Group

Age Group	**Child Repeated Any Grades**		Total
	Yes	No	
6-11 years old	208	3801	4009
12-17 years old	417	4897	5314
Total	625	8698	9323

Table 2: Frequency Counts for all Dependent Variables

Variables		Child Repeated Any Grades				Total
		Yes		No		
		6-11 yrs	12-17 yrs	6-11 yrs	12-17 yrs	All ages
Children who have deafness or problems with hearing						
	Yes	85	140	763	914	1902
	No	123	277	3038	3983	7421
Race						
	White	148	303	2914	3802	7,167
	Black/African American	21	51	274	358	704
	American Indian or Alaska Native	5	7	40	52	104
	Asian	5	18	198	277	498
	Native Hawaiian and Other Pacific Islander	1	5	23	45	74
	Two or More Races	24	33	326	333	716
Ethnicity						
	Hispanic or Latino Origin	28	59	532	666	1,285
	Not Hispanic or Latino Origin	180	358	3269	4231	8,038
Sex assigned at birth						
	Male	117	259	1972	2497	4,845
	Female	91	158	1829	2400	4,478
Household income						
	0-99% FPL	54	104	507	632	1,297
	100-199% FPL	52	90	684	833	1,659
	200-399% FPL	57	115	1128	1404	2,704
	400% FPL or greater	45	108	1482	2028	3,663

Two logistic regression models were constructed to analyze the factors influencing school retention among children. Model 1 was a main effects model that included predictors such as hearing impairments, age group, sex, race, ethnicity, income levels, and a binary variable indicating pre- or post-COVID-19 periods. This model aimed to identify the direct effects of these variables on school retention.

Model 2 expanded upon the first by incorporating interaction terms to explore whether the effects of the main predictors varied by the COVID-19 period. Specifically, interactions between COVID-19 and hearing impairments, age, race, and income levels were tested to determine if the pandemic modified the relationships between these predictors and school retention.

Model 1 revealed significant predictors of school retention among children, and the results are depicted in Table 3. Hearing impairments were associated with higher odds of retention, with children experiencing hearing difficulties being more than twice as likely to be held back compared to those without hearing issues (OR = 2.20, $p < 0.001$). Age was also a significant factor, with older children (12-17 years) showing increased odds of retention compared to younger children (6-11 years) (OR = 1.67, $p < 0.001$). Females had lower odds of retention compared to males (OR = 0.70, $p < 0.001$). Additionally, income levels were inversely related to retention, with lower-income groups having higher odds of retention compared to the highest income group. The post-COVID period was associated with slightly lower odds of retention (OR = 0.78, $p < 0.01$), suggesting some mitigating effects of the pandemic on school retention rates.

Table 3: Main Effects Model Results (Model 1)

Predictor		B	Std. Error	Odds Ratio (Exp(B))	95% CI for Exp(B)	p-value
(Intercept)		-2.44939	0.16889			< .001
Hearing Difficulties		0.78794	0.08956	2.199	[1.849, 2.616]	< .001
Age 12-17		0.5141	0.0896	1.672	[1.398, 2.001]	< .001
Sex assigned at birth: Female		-0.36206	0.08604	0.696	[0.593, 0.817]	< .001
Race (ref. White)						
	Black / African American	0.29935	0.13891	1.349	[1.029, 1.768]	0.03116
	American Indian or Alaska Native	0.45626	0.31821	1.578	[0.847, 2.941]	0.15161
	Asian	-0.29212	0.22222	0.747	[0.482, 1.159]	0.18866
	Native Hawaiian and Other Pacific Islander	0.02582	0.43838	1.026	[0.430, 2.452]	0.95304
	Two or More Races	0.22971	0.14923	1.258	[0.959, 1.651]	0.12373
Ethnicity: Not Hispanic or Latino Origin		0.18686	0.12792	1.205	[0.943, 1.540]	0.14409
Household Income (ref. 0-99% FPL)						
	100-199% FPL	-0.35948	0.12442	0.698	[0.550, 0.885]	0.00386
	200-399% FPL	-0.6697	0.12029	0.512	[0.409, 0.640]	< .001
	400% FPL or greater	-1.06922	0.12377	0.343	[0.273, 0.432]	< .001
Post-Covid		-0.24756	0.08599	0.781	[0.667, 0.914]	0.00399

Model 2, which included interaction terms to explore COVID-19 period effects, provided additional insights into the relationships between predictors and school retention (see Appendix B Table B1). While the main effects of hearing impairments, age group, sex, and income levels remained significant, the interactions revealed no substantial changes in these relationships during the post-COVID period. For instance, the interaction between hearing impairments and the COVID-19 period was not significant, suggesting that the pandemic did not significantly alter the impact of hearing difficulties on school retention ($p > 0.3$). Similarly, interactions between the COVID-19 period and various race categories, as well as income levels, did not yield significant results. This indicates that the effects of these predictors on school retention were generally consistent before and after the pandemic, with no notable moderation by the COVID-19 period.

Model 1 had an AIC of 4337.1, suggesting a reasonable fit to the data. The Cox & Snell R-squared and Nagelkerke R-squared values were 0.025 and 0.063, respectively, indicating that while the model explained a modest portion of the variance, it captured key predictors of grade retention. Model 2, which incorporated interaction terms, showed a slightly higher AIC of 4349.9, reflecting additional complexity without a substantial improvement in fit. The similar R-squared values between the models suggest that while Model 2 provided deeper insight into potential interaction effects, it did not greatly enhance the explanatory power over Model 1.

Discussion

Model 1 revealed that hearing impairments significantly increased the likelihood of grade retention, with affected children being more than twice as likely to be retained compared to their peers without hearing problems. This supports existing literature that highlights the educational challenges faced by children with hearing difficulties, such as communication barriers and limited access to necessary accommodations (Moeller, 2000; Lieu, 2013). These findings highlight the need for targeted educational interventions and support systems to help mitigate the disadvantages faced by this vulnerable group.

Age was another significant predictor, with older children (12-17 years) having higher odds of grade retention than younger children (6-11 years). This may be explained by the increasing academic demands as children progress through school, which can amplify existing challenges and contribute to retention decisions (Jimerson et al., 2002). The results also suggest that gender played a role, with females being less likely to be retained compared to males. This could reflect gender differences in behavioral and academic outcomes, where boys are more

frequently reported to experience learning and behavioral difficulties that might prompt retention (Skiba et al., 2016).

Socioeconomic status, as measured by income levels, showed an inverse relationship with grade retention. Children from lower-income households had higher odds of being retained compared to those from higher-income families. This finding aligns with research demonstrating that socioeconomic status is a strong predictor of academic achievement and related outcomes (Sirin, 2005). Poverty can limit access to educational resources, support services, and extracurricular opportunities that bolster academic success, increasing the likelihood of retention for children in lower-income families.

The impact of the COVID-19 pandemic was also a focal point of this study. Model 1 indicated that children were less likely to be retained during the post-COVID period ($OR = 0.78$, $p < 0.01$). This reduction in retention rates may be attributed to the policy changes and academic leniencies implemented during the pandemic. Schools across the nation adapted to the pandemic by modifying grading policies, implementing pass/fail systems, or promoting students automatically to avoid exacerbating the educational setbacks caused by remote learning challenges. While these strategies aimed to support students, it is important to evaluate their long-term effects on educational outcomes and ensure that academic standards are maintained.

Conclusion

This study highlights the significant predictors of grade retention among school-aged children, emphasizing the persistent influence of hearing impairments, socioeconomic status, age, and gender. The COVID-19 pandemic, while associated with a decrease in overall retention

rates, did not fundamentally change the relationships between these key predictors and retention outcomes. This suggests that while pandemic-era policies provided short-term relief, they did not address deeper, structural inequities that impact educational performance in children. Ensuring equitable educational outcomes requires targeted efforts to support children who face systemic disadvantages, such as those with hearing impairments or from lower-income families.

The results from this study are valuable because they emphasize the need for sustained funding and resources to support children with disabilities and disadvantaged socioeconomic backgrounds. For example, schools should implement comprehensive intervention programs that provide tailored support to these groups. Additionally, future policies must prioritize adaptability and resilience to ensure that educational systems can continue to meet the needs of all students during periods of disruption.

Future research should investigate the long-term academic and social impacts of the pandemic, particularly for vulnerable populations. Studies could explore how interventions during the COVID-19 period influenced students' educational trajectories over time and assess which strategies were most effective in promoting academic resilience. Understanding these aspects will be crucial for developing informed policies that not only mitigate immediate educational challenges but also promote lasting equity and success for all students.

It is important to note that this study has several limitations that should be considered when interpreting the findings. First, the data was self-reported by parents or guardians, which may introduce bias due to inaccuracies in reporting or recall errors. Second, the NSCH dataset is cross-sectional, limiting the ability to draw causal inferences about the relationships between the predictors and grade retention. Third, while the study included a variety of demographic and socioeconomic variables, other unmeasured factors, such as support programs and resources at

the local level, could influence retention outcomes. Finally, the analysis did not account for potential regional variations in school responses to the COVID-19 pandemic, which might have affected retention differently across various states and districts.

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Appendix A

Collinearity statistics and Hosmer-Lemeshow Test results

Table A1: Collinearity Statistics

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	3.876	1.100		3.525	<.001		
	Income based on federal poverty level status	-.118	.111	-.011	-1.069	.285	.955	1.047
	Race of Selected Child, Detailed	.017	.066	.003	.252	.801	.991	1.009
	Age in 2 groups	-.002	.232	.000	-.007	.994	.999	1.001
	Sex of child	.263	.230	.012	1.142	.253	1.000	1.000
	Children who have deafness or problems with hearing	.411	.287	.015	1.430	.153	.989	1.012
	Before or After COVID	-.096	.237	-.004	-.405	.686	.996	1.004
	Hispanic Origin of Selected Child, Recode	-.744	.340	-.023	-2.191	.028	.959	1.042

a. Dependent Variable: Child Repeated Any Grades

Table A2: Hosmer-Lemeshow Test Results

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	14.109	8	.079

Appendix B

Table B1: Main Effects Model with added Interaction Terms (Model 2)

Predictor		B	Std. Error	Odds Ratio (Exp(B))	95% CI for Exp(B)	p-value
(Intercept)		-2.516048	0.216928			< .001
Hearing Difficulties		0.895519	0.136984	2.448	[1.886, 3.180]	< .001
Post-Covid		-0.135226	0.239697	0.874	[0.544, 1.405]	0.57265
Age 12-17		0.483017	0.137796	1.621	[1.227, 2.142]	< .001
Sex assigned at birth: Female		-0.361706	0.086158	0.697	[0.593, 0.818]	< .001
Race (ref. White)						
	Black / African American	0.297936	0.219145	1.347	[0.883, 2.054]	0.17398
	American Indian or Alaska Native	1.056763	0.473282	2.877	[1.139, 7.267]	0.02556
	Asian	-0.245712	0.339643	0.782	[0.400, 1.529]	0.46941
	Native Hawaiian and Other Pacific Islander	0.819557	0.567458	2.27	[0.750, 6.877]	0.14867
	Two or More Races	0.124348	0.255317	1.132	[0.692, 1.854]	0.62623
Ethnicity: Not Hispanic or Latino Origin		0.18268	0.127832	1.2	[0.932, 1.545]	0.15299
Household Income (ref. 0-99% FPL)						
	100-199% FPL	-0.377089	0.201352	0.686	[0.452, 1.041]	0.0611
	200-399% FPL	-0.613327	0.187974	0.541	[0.373, 0.785]	0.0011
	400% FPL or greater	-0.970347	0.191126	0.379	[0.258, 0.554]	< .001
Covid Interaction Terms						
	Hearing*Covid	-0.180806	0.181321	0.835	[0.581, 1.201]	0.31869
	Hearing*Age 12-17	0.05412	0.181756	1.056	[0.728, 1.531]	0.76589
	Black / African American*Covid	0.005596	0.28257	1.006	[0.586, 1.728]	0.9842
	American Indian or Alaska Native*Covid	-0.981324	0.645171	0.375	[0.107, 1.313]	0.12825
	Asian*Covid	-0.06941	0.448907	0.933	[0.386, 2.260]	0.87712
	Native Hawaiian and Other Pacific Islander*Covid	-1.539586	0.9245	0.215	[0.037, 1.241]	0.09585
	Two or More Races*Covid	0.162039	0.314866	1.176	[0.632, 2.189]	0.60681
	100-199% FPL*Covid	0.0292	0.25621	1.03	[0.628, 1.691]	0.90926
	200-399% FPL*Covid	-0.09592	0.243843	0.909	[0.568, 1.455]	0.69405
	400% FPL or greater*Covid	-0.170776	0.249589	0.843	[0.518, 1.372]	0.49383