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Outcomes in Rural and Urban Settings for Students With Disabilities

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Abstract

Limited quantitative research has examined similarities and differences between the academic achievement and discipline outcomes, including suspensions, of students with disabilities in rural and urban schools. Therefore, we leveraged a statewide longitudinal data set to explore academic achievement and discipline outcomes for students with disabilities in rural schools and compared those outcomes to students with disabilities in urban schools. We then followed up with analyses to evaluate differences by disability category. The full data set of students in urban and rural schools included 1,306,134 observations from 366,529 unique students with disabilities across 11 consecutive years. We used a series of linear mixed-effects models to evaluate academic achievement for students in Grades 3 to 8 and generalized linear mixed-effects models to evaluate two discipline outcomes, in- and out-of-school suspensions. Overall, we found that students with disabilities in rural schools had lower reading scores, fewer in-school suspensions, and more out-of-school suspensions. Unique patterns across disability categories also emerged.

Keywords

special education, academic achievement, discipline, rural setting

Research has consistently documented different academic and behavioral outcomes for students with and without disabilities, including reading (Gilmour et al., 2019) and mathematics achievement (Stevens et al., 2015), and suspension from school (U.S. General Accountability Office [GOA], 2018). Data from the most recent fourth grade National Assessment of Educational Performance (NAEP; U.S. Department of Education, Institute of Education Sciences, National Center for Educational Statistics, [NCES], 2022a) indicate that 74% of students with disabilities (SWD) perform at the Basic reading achievement level and 55% perform at the Basic mathematics achievement level. These figures are particularly concerning when compared with students without disabilities, with only 29% at the Basic reading achievement level and 15% at the Basic mathematics achievement level (NCES, 2022b). Given the clear achievement discrepancies, comparisons of SWD to those without disabilities by their school's locale (i.e., urban or rural setting; Geverdt, 2015), as well as student characteristics, such as race/ethnicity, gender, may help explain small differences between the groups. As such, moderators of SWD's achievement, and potentially, discipline outcomes, may be more useful if the analyses include only SWD, excluding students without disabilities. For example, Wei et al. (2013) found that Black and Hispanic SWD performed statistically significantly lower in mathematics, while Wei et al. (2011) found that Black and Hispanic SWD performed statistically significantly lower in reading. Although different moderators of achievement and discipline outcomes for SWD have been explored in the literature, particularly race (e.g., Gage et al., 2019), little research has examined differences in reading and mathematics achievement and disciplinary outcomes for SWD by locale, particularly differences between SWD in rural and urban schools. This study was designed to address this gap in the literature by using longitudinal statewide data from North Carolina to explore differences in achievement and discipline of SWD in rural and urban settings.

Achievement and Suspension Differences Between SWD and Typically Developing Students

As noted, SWD perform significantly lower in both reading and mathematics than students without disabilities. When

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comparing SWD only, there appears to be significant heterogeneity in achievement by disability category. Wei et al. (2011) and Wei et al. (2013) used data from the Special Education Elementary Longitudinal Study (SEELS) to evaluate growth trajectories in reading and mathematics achievement by disability category. Wei et al. (2011) examined student performance on the Woodcock-Johnson III Test of Achievement (WJ-III; Woodcock et al., 2001) reading subtests measuring letter-word identification and reading comprehension. The authors found that students with learning disabilities (LD) performed statistically significantly lower than students with speech and language impairments (SLI) and emotional disturbance (ED), and significantly better than students with intellectual disabilities (ID) and multiple disabilities. Wei et al. (2013) examined the performance of SWD on the WJ-III mathematics subtests focused on applied problems and calculations. Using the same modeling approach, the authors found that students with SLI performed statistically significantly better than students with LD, while students with ID and multiple disabilities performed significantly lower than students with LD. No differences were found between students with ED and LD.

Results are less clear for suspensions. Morgan et al. (2019) used the Early Childhood Longitudinal Study-Kindergarten Class of 1998 to 1999 to evaluate differences in the number of suspensions for students with and without disabilities. After controlling for myriad confounds, the authors found that SWD were not significantly more at-risk for being frequently suspended than students without disabilities. In addition, the authors found that students with ED were also not more likely to have frequent suspensions. However, other studies have found different results. For example, Sullivan et al. (2013) used data from a large midwestern school district and found that SWD were significantly more likely to be suspended than students without disabilities after controlling for available student characteristics.

As for SWD, research has found significant heterogeneity by disability category. Sullivan et al. (2013) focused exclusively on SWD and found that students with LD and EBD were significantly more likely to be suspended than students with ID. More recently, Gage et al. (2019) examined disproportionate discipline for White and Black SWD using data from all U.S. public schools (>90,000 schools) and found that Black SWD are significantly more likely to receive in-school suspension (ISS) and out-of-school suspension (OSS) than White SWD. Gage et al. (2020) used a similar approach and explored disproportionate discipline for White SWD and Hispanic SWD. Again, the authors found that Hispanic students were significantly more likely to receive suspensions than White students, although the risk ratio was not as large as it was in the comparison between Black and White SWD.

Achievement and Suspension Differences Between SWD and Typically Developing Students in Rural and Urban Schools

Data suggest broad demographic differences for students in rural and urban schools. Approximately 18% of U.S. public school students are educated in rural settings, while 30% are educated in urban settings (U.S. Department of Education, Institute of Education Science, National Center for Education Statistics [NCES], 2020). Seventy-two percent of students in rural settings are White compared with 30% in urban settings. In rural settings, 9% of students are Black and 12% are Hispanic as compared with 23% of students Black and 25% Hispanic in urban settings. Interestingly, the percentage of SWD is equivalent by locale, with 27% of SWD educated in rural settings and 28% of SWD educated in urban settings. Thus, although there are clear racial and ethnic differences in the populations served, the percentage of SWD is equivalent.

As noted, there is limited research specifically comparing outcomes for SWD in rural and urban settings. Much of the research has focused on the prevalence of disability in rural and urban settings. For example, research has found higher disability prevalence rates for adults living in rural settings compared with urban settings, including cognitive disabilities (Zhao et al., 2019). Similarly, Zablotsky et al. (2019) found that there were more children between 3 and 17 years with developmental disabilities in rural settings compared with urban settings. Other research has focused on discrepancy of services between rural and urban settings. For example, Hott et al. (2020) examined Individualized Education Programs (IEPs) of students with mathematics LD from 15 rural school districts. The authors found insufficient support and specificity in those IEPs to ensure students with mathematics LD in rural schools receive the necessary intervention and instruction to increase their mathematics performance.

Achievement Differences in Rural and Urban Schools. There has been relatively little quantitative, published research focused on comparing achievement and discipline in rural and urban schools over the past 20 years, especially for SWD. A number of reports and studies examined achievement prior to 2000 (e.g., Edington & Koehler, 1987). For example, Fan and Chen (1999) used the National Education Longitudinal Study of 1988 (NELS:88) to evaluate achievement differences for secondary students in rural and urban settings, disaggregated by race. The authors found that eighth-grade White students in rural schools performed significantly higher in reading and mathematics than White students in urban schools, while Hispanic students in rural schools performed at a lower level than Hispanic students in urban settings. However, the differences between students were no longer evident in 10th and 12th grades and the effect sizes were all small, suggesting the differences may not be meaningful.

With regards to SWD, a number of unpublished data sources provide insight into similarities and differences in achievement by locale. The SEELS was a federally funded study of educational performance of SWD across the United States. Students with disabilities included in SEELS completed a direct assessment, which included the WJ-III subtests described above. Data from the last wave of data collection (2005–2006) suggest that SWD in rural schools performed higher, scaled as percentile ranks, than SWD in urban schools in both mathematics and reading. For applied problems, SWD in rural schools performed, on average, at the 35th percentile, and SWD in urban schools performed at the 27th percentile. Similarly, for passage comprehension, SWD in rural schools performed at the 28th percentile, while SWD in urban schools performed at the 22nd percentile.

Results from the 2019 NAEP Reading assessment suggest that SWD in rural schools scored higher (180) than SWD in urban schools (173). The difference between the locales is statistically significant. Results were the same for mathematics, with SWD in rural schools performing higher (213) than SWD in urban schools (204). The NAEP data explorer also allows users to examine differences between students in specific states. In North Carolina, there was no significant difference in reading or mathematics performance for SWD in rural and urban schools. Although these data are important and provide useful insight into potential achievement differences between rural and urban schools for SWD, not all SWD participate in the NAEP and, notably, the statistical test does not account for potential confounds on the difference by locale.

Discipline Differences in Rural and Urban Schools. Research on discipline outcomes, particularly suspensions, for SWD in rural and urban schools is much more limited than achievement. Achilles et al. (2007) used SEELS data and estimated the likelihood a parent reported that a student with disability had been excluded from school, including OSS and expulsions, and included urban setting as a predictor in the model. The authors compared urban school settings to a combined suburban and rural category. Model results suggested that SWD in urban settings were more likely to experience school exclusion, and that students with ED, specifically, in urban schools were more likely to experience school exclusion. These results are consistent with research including all students, which found students in urban schools are more likely to experience school suspensions (e.g., Noltemeyer & Mcloughlin, 2010). However, data for (ISS) suggest that there are no differences in ISS use by locale (Cholewa et al., 2018). Thus, more research is needed to begin to better understand differences in disciplinary patterns, particularly use of suspensions, for SWD in rural and urban schools.

Purpose

To date, little research has specifically examined differences in reading and mathematics achievement and disciplinary outcomes for SWD by locale, particularly differences between SWD in rural and urban schools. Further, fewer studies have included student- and school-level covariates to control for potential confounds, including race/ethnicity, gender, and school characteristics. Last, studies have not specifically examined differences in achievement and discipline by disability category in rural and urban schools. Therefore, we analyzed a student-level longitudinal state data set to compare achievement and discipline for SWD. The following research questions guided our study:

Research Question 1 (RQ1): Are there differences in reading and mathematics achievement for SWD in rural and urban schools, controlling for student and school confounds (age, race/ethnicity, gender, school type, total enrollment, etc.)?
Research Question 2 (RQ2): Are there differences in reading and mathematics achievement for different disability categories in rural and urban schools?
Research Question 3 (RQ3): Are there differences in ISS and OSS for SWD in rural and urban schools, controlling for student and school confounds (age, race/ethnicity, gender, school-type, total enrollment, etc.)?
Research Question 4 (RQ4): Are there differences in ISS and OSS for different disability categories in rural and urban schools?

Method

Sample

We used data from the North Carolina Education Research Data Center (NCERDC), a collaborative project between the North Carolina Department of Public Instruction and Duke University's Center for Child and Family Policy. The NCERDC houses data from students in North Carolina schools from the mid 1990s to 2018 across a myriad of variables, including achievement, discipline, and demographics. Unfortunately, not all data can be reliably matched longitudinally at the student level for all years. For this study, we were able to accurately identify students receiving special education services across time from the

2007 to 2008 school year to the 2017 to 2018 school year (11 consecutive years). We merged student demographic data, including disability category, race/ethnicity, gender, and age/grade, with state achievement test data and discipline data. We then collected school-level data from the U.S. Department of Education's National Center for Educational Statistics (NCES), notably, locale data. We merged the school-level demographic data from NCES to the student-level demographic, achievement, and discipline data. The locale indicator is based on U.S. Census criteria, which define locales as (a) urban, (b) suburban, (c) town, and (d) rural (Geverdt, 2015). For this study, we reduced the sample to SWD attending public schools located in either urban or rural settings based on NCES designations; we removed all students in suburban and town settings from the data set.

The data set included 1,306,134 observations from 366,529 unique SWD across 11 consecutive years. All SWD in North Carolina with available data and attending rural or urban schools during the 2007 to 2008 school year were included. We defined this group as Cohort 1. Each subsequent year, we added students newly identified as having a disability and identified them as a new cohort of students. Cohort 1 included 119,626 students, or ~39% of the total sample. Each subsequent cohort included approximately 21,000 students, except the 2016 to 2017 school year cohort, which only included 6,434 students. We were unable to ascertain the specific reason for the drop in newly identified students, but believe it to be a data error and not reflective of a broad state-wide drop in SWD identification. As our goal was not to model growth rates, we chose to keep the sample, but control for potential confounding effects in the analysis plan.

Overall, approximately 54% of the students were White, 34% were Black, 7% were Hispanic, 1% were Asian, 1% were Native American, and 3% were multi-racial. Sixty-seven percent of the students were male, and the average age of the students was 11.6 years. There were 154 rural schools and 267 urban schools. Approximately 59% of the SWD were educated in rural schools, while 41% were educated in urban schools. Demographics by locale are presented in Table 1. There were more students with autism and ED in urban schools, while there were more students with mild ID, LD, and SLI in rural schools. There were twice as many Black students in urban settings and twice as many White students in rural settings. Almost all of the students in the data set were educated in a regular public school. Less than 1% of rural SWD were educated in a public special education-focused school, compared with 3% of SWD in urban locales. Almost 5% of SWD in urban locales attended a public charter school, compared with <2% of SWD in rural locales. The rural schools were smaller in enrollment and less ethnically and racially diverse than urban schools.

Table 1. Student and School Demographics by Locale.

Demographic	Rural (%)	Urban (%)
Student level		
Disability		
Autism	6.2	9.2
Deaf/blind	0.0	0.0
Developmental disability	5.5	5.5
Deaf	0.0	0.1
Emotional disturbance	2.9	4.1
Hearing impairment	0.9	1.2
Intellectual disability (not defined)	1.2	1.1
Intellectual disability—mild	7.3	5.8
Intellectual disability—moderate	1.9	2.3
Intellectual disability—severe	0.3	0.5
Learning disability	39.1	37.0
Multiple disabilities	1.1	1.8
Other health impairment	16.9	17.5
Orthopedic impairment	0.4	0.5
Speech–language impairment	15.7	12.7
Traumatic brain injury	0.3	0.3
Visual impairment	0.3	0.4
Male	67.2	67.3
Race		
American Indian	1.2	1.3
Asian	0.4	0.6
Black	23.3	48.3
Hispanic	6.0	7.4
Multi-racial	3.2	4.2
White	66.0	38.2
Age (*M* years)	11.5	11.6
School level		
School type		
General education	99.1	95.4
Special education	0.4	3.0
Vocational	0.0	0.0
Alternative	0.4	1.6
Charter	1.8	4.5
School enrollment (*M*)	670.9	876.8
% Economically disadvantaged	63.2	63.4
Male	51.9	52.0
White	60.2	31.1
Black	19.1	42.0
Hispanic	13.8	18.4

Measures

Academic achievement. We used the End-of-Grade (EOG) English Language Arts (ELA) and Mathematics vertical scale scores as the primary achievement measures in this study. The EOG assessments are given to all public-school students in North Carolina at the end of Grades 3 to 8. Both the ELA and mathematics assessments align with the North Carolina Essential Standards in ELA and Mathematics and are used for the evaluation of student and school performance annually. Psychometric evaluation of each test was conducted by the North Carolina Department of Education. The ELA reliability ranged from α = .88 to α = .92 across the six assessed grade levels (Mbella et al., 2016a). Mathematics reliability ranged from α = .91 to α = .94 across the six assessed grade levels (Mbella et al., 2016b). Validity was evaluated at the item- and scale-level using item response theory and classical test theory approaches (see Mbella et al., 2016a, 2016b).

Discipline. Data from the NCERDC include records of all ISS and OSS incidents. An ISS typically involves a student spending their day in school, but segregated from their peers as a consequence for a rule violation, while OSS involves the removal of the student from the school, typically for 1 to 10 days as a consequence for a significant rule violate (e.g., physical fight) or repeated rule violations (see U.S. Department of Education, Safe and Supportive Learning, 2020 for legal definitions). We aggregated incidents by student ID for each year to calculate the total number of ISS and OSS incidents per student. Only 2% of students had an ISS and 3% had an OSS. Therefore, we created a dichotomous indicator for each student for each year, indicating whether the student experienced an ISS or an OSS.

Data Analysis

The primary purpose of this study was to examine differences by setting using the locale classification on achievement and discipline outcomes for SWD. As noted, the data set included 11 consecutive years, reporting data from 11 unique cohorts of SWD. Therefore, we used a mixed-effects modeling, also referred to as multilevel modeling, to estimate overall treatment effects. We estimated a series of linear mixed-effects models for the two continuous achievement measures and generalized linear mixed-effect models for the two discipline outcomes. The first model for each outcome was a longitudinal model with locale (e.g., urban or rural) as a covariate, along with 11 other student- and school-level covariates, including the cohort each student entered into the data set. This model provides the estimates of change across time, controlling for each covariate. The second model included an interaction effect between time and locale (e.g., urban or rural) to estimate differences in growth trajectories for SWD in urban and rural schools. The last model included an interaction effect between locale (e.g., urban and rural) and disability category to evaluate differences in outcome by disability category. The last model controls for time, but the primary outcome was the locale and disability category interaction effects. All models included two random effects, one for student and one for school. Thus, the models accounted for observations across time nested in students nested in schools. The achievement model formula for the final model is as follows:

$$y_{ijt} = \gamma_0 + \gamma_1 \text{Time}_{ij} + \gamma_2 \text{Urban}_{ijt} \times \text{Disability}_{ijt} + \sum_{c=1}^{11} \gamma_c X_{cijt} + \mathrm{u}_{oj} + \mathrm{u}_{0t} + \varepsilon_{ijt},$$

where y_{ijt} is the achievement vertical scale score student *i* in school *j* during year *t*, γ_0 is the intercept, γ_1 is the effect of time for student *i* in school *j*, and γ_2 is the interaction effect of urban local and disability category, estimating the effect of locale for specific disability categories on achievement. The model includes 11 covariates represented by X_{cijt}, which are related to the outcome through the γ_c coefficients. The model has three random effects: u_{oj} is the random intercept of school *j*, u_{ot} is the random intercept for time, and ε_{ijt} is the observation-level residual.

We centered all continuous covariates (student age and the percentage of students economically disadvantaged and the percentage of White, Black, and Hispanic students at each school). We did not center time because the largest proportion of students was in the first cohort, which we coded at time 0. All models were estimated using the *lme4* (Bates et al., 2015) in R (R Core Team, 2017).

Results

Academic Achievement Outcomes

First, we calculated the unadjusted mean and standard deviation for the ELA and mathematics scale scores by locale (e.g., urban or rural). The standard deviation can then be used to estimate a standardized effect size (*d*) for comparing locale. The average ELA score for SWD in rural schools was 347 (*SD* = 121) and urban schools was 339 (*SD* = 126). The average mathematics score for SWD in rural schools was 341 (*SD* = 127), while the average score for SWD in urban schools was 330 (*SD* = 133). The unadjusted descriptive statistics suggest that SWD in rural schools score higher than SWD in urban schools in both ELA and mathematics.

Differences in Reading and Mathematics Achievement for SWD in Rural and Urban Schools

The first models examined differences in achievement for students with and without disabilities. We examined the intraclass correlation coefficient (ICC) to evaluate the amount of variance accounted for by each of the random effects (i.e., students and schools). The ICC for students was .54, suggesting that 54% of the variance in ELA achievement is between students, while the ICC for school was .19, suggesting that 19% of the variance is between

Table 2. Academic Achievement and Locale Mixed-Effects Models.

	English language arts		Mathematics	
Parameter	Estimate	*SE*	Estimate	*SE*
Intercept	262.35***	3.10	246.74***	2.04
Time	6.09***	0.08	9.28***	0.08
Rural	−1.58***	0.44	0.39	0.44
Age	−4.45***	0.08	−2.70***	0.09
Male	2.03***	0.41	4.57***	0.44
Black	6.35***	0.41	4.49***	0.42
Hispanic	7.54***	0.62	9.44***	0.62
Asian	1.45	1.99	5.28**	1.91
Native American	−0.99	1.37	3.08*	1.34
Multiracial	7.73***	0.81	7.22***	0.81
Special education school	−177.95***	1.77	−148.81***	1.76
Vocational school	−247.48***	32.78	−169.69***	32.08
Alternative school	−38.21***	1.53	−20.80***	1.50
Charter school	29.72	51.53	20.54	32.85
Cohort 2	19.73***	0.78	20.78***	0.82
Cohort 3	27.86***	0.84	27.71***	0.88
Cohort 4	37.79***	0.83	38.25***	0.89
Cohort 5	53.14***	0.86	53.11***	0.92
Cohort 6	66.14***	0.90	67.29***	0.96
Cohort 7	64.99***	0.97	67.78***	1.03
Cohort 8	68.65***	1.07	72.66***	1.13
Cohort 9	71.93***	1.00	74.26***	1.06
Cohort 10	69.15***	1.90	71.45***	2.03
Cohort 11	69.64***	1.54	67.93***	1.62
Enrollment	−0.07***	0.00	−0.04***	0.00
% Economically disadvantaged	3.58***	0.91	4.20***	0.92
% White	−16.81***	2.29	0.52	2.33
% Black	−43.56***	2.36	−24.61***	2.40
% Hispanic	−1.71	2.50	1.33	2.54
Random effects				
Student	7,400		8,754	
School	2,645		1,074	
Residual	3,630		3,463	

Note. The English language arts model included 648,869 observations, 235,363 students, 289 schools. The mathematics model included 673,583 observations, 238,787 students, 289 schools.
*$p < .05$. **$p < .01$. ***$p < .001$.

schools. The results for mathematics indicate that 66% of the variance was between students, while only 8% of the variance was between schools. The results for the first models for ELA and mathematics are presented in Table 2. The primary coefficient of interest is the rural parameter, which is coded as 0 for urban and 1 for rural settings. The coefficient for the ELA model is negative and statistically significant, suggesting that SWD in rural schools perform significantly lower in ELA than SWD in urban schools. However, given the coefficient size (−1.58) and the standard deviation (pooled $SD = 123.5$), the effect size is very small ($d = -0.01$). No differences were found between rural and urban settings for SWD's mathematics performance.

The time coefficient for both the ELA and mathematics models was positive and statistically significant. Therefore, we estimated models with an interaction term for time and locale (e.g., rural or urban). The interaction term was the only coefficient of interest in these models; full models can be obtained from the first author. The interaction term coefficient for the ELA model was −1.84 ($SE = 0.08$, $p < .000$), while the interaction term coefficient for the mathematics model was −1.26 ($SE = 0.08$, $p < .000$). The results suggest that SWD in rural schools had a negative slope, while students in urban schools had a positive slope. Put differently, the achievement of SWD in rural schools declined across the eleven years of data.

Table 3. Disability and Locale Mixed-Effects Models for Achievement.

	English language arts		Mathematics	
Parameter	Estimate	*SE*	Estimate	*SE*
Intercept	336.68***	3.05	304.64***	2.01
Rural	2.28***	0.49	4.40***	0.49
Emotional disturbance (ED)	8.74***	1.06	0.43	1.07
Other health impairment (OHI)	1.40*	0.57	−5.88***	0.58
Speech–language impairment (SLI)	8.18***	0.76	22.89***	0.76
Autism (AU)	−94.40***	0.84	−103.89***	0.86
Deaf/blind (DB)	−189.25***	14.80	−176.37***	15.44
Developmental disability (DD)	−116.21	68.56	−122.47	67.22
Deaf (DF)	−50.67***	7.09	−52.46***	7.04
Hearing impairment (HI)	−6.61**	2.20	−11.57***	2.24
Intellectual disability—not defined (ID)	−110.34***	1.53	−129.25***	1.46
Intellectual disability—mild (IDMI)	−78.62***	0.90	−110.48***	0.90
Intellectual disability—moderate (IDMO)	−228.96***	1.45	−236.60***	1.44
Intellectual disability—severe (IDSE)	−276.70***	3.29	−279.90***	3.27
Multiple disabilities (MU)	−249.03***	1.94	−254.64***	1.97
Orthopedic impairment (OI)	−45.39***	3.45	−60.76***	3.48
Traumatic brain injury (TB)	−87.89***	4.42	−95.67***	4.50
Visual impairment (VI)	−4.23	3.90	−7.97*	3.95
Rural × ED	−11.78***	1.37	−11.42***	1.37
Rural × OHI	−5.90***	0.71	−6.09***	0.71
Rural × SLI	−2.23*	0.95	−5.21***	0.95
Rural × AU	4.87***	1.06	5.08***	1.06
Rural × DB	88.76***	21.38	59.93**	20.83
Rural × DD	135.86	86.60	164.37	85.41
Rural × DF	13.04	12.48	0.78***	12.43
Rural × HI	5.84*	2.77	5.35	2.78
Rural × ID	10.27***	1.92	5.74**	1.83
Rural × IDMI	−5.29***	1.06	−1.09	1.06
Rural × IDMO	−17.25***	1.79	−14.30***	1.76
Rural × IDSE	−23.18***	4.41	−22.76***	4.35
Rural × MU	−28.83***	2.46	−25.71***	2.44
Rural × OI	10.49*	4.23	13.96**	4.21
Rural × TB	13.61*	5.48	11.19*	5.52
Rural × VI	−3.34	4.95	−3.65	4.95

Note. Learning disability is the reference group.
*$p < .05$. **$p < .01$. ***$p < .001$.

Differences in Reading and Mathematics Achievement for Different Disability Categories in Rural and Urban Schools

The last series of models examined the differences in ELA and mathematics achievement by disability category and locale (e.g., urban or rural). Model results are presented in Table 3 (the same covariates were included but are not reported). Students with LD served as the reference group. The results suggest significant differences in achievement among the disability categories. Comparisons among students with ED, Other Health Impairments (OHI), and SLI suggest that all three groups performed higher in reading, no differences were found between ED and LD in mathematics, while students with OHI performed significantly lower and students with SLI performed significantly higher. Students with more significant disabilities (e.g., ID, traumatic brain injury [TBI]) performed significantly lower than students with LD. The results comparing the performance by locale suggested significant differences across many of the disability categories. Students with ED, OHI, and SLI performed significantly lower in rural settings than students with LD. The difference was largest for students with ED, with an interaction effect size of $d = -0.09$. The pattern was less clear for students with more significant disabilities.

Table 4. Discipline Outcomes and Locale Generalized Mixed-Effects Models.

	In-school suspension		Out-of-school suspension	
Parameters	Log(OR)	OR	Log(OR)	OR
Intercept	−3.74***	0.02	−3.36***	0.03
Time	−0.17***	0.84	−0.23***	0.80
Rural	−0.06***	0.95	0.04*	1.04
Age	0.16***	1.17	0.11***	1.11
Male	0.18***	1.20	0.43***	1.53
Black	0.15***	1.16	0.33***	1.39
Hispanic	0.09**	1.10	0.08**	1.08
Asian	0.00	1.00	−0.20*	0.82
Native American	−0.05	0.95	−0.19**	0.83
Multiracial	0.14***	1.14	0.22***	1.25
Special education school	−1.86***	0.16	−0.87***	0.42
Vocational school	−9.14	0.00	−8.62	0.00
Alternative school	−0.72***	0.48	0.08	1.08
Charter school	−0.22	0.80	0.24	1.28
Cohort 2	−0.11***	0.89	0.05*	1.05
Cohort 3	0.04	1.04	0.14***	1.15
Cohort 4	0.22***	1.24	0.28***	1.32
Cohort 5	0.39***	1.48	0.49***	1.63
Cohort 6	0.50***	1.65	0.62***	1.85
Cohort 7	0.56***	1.75	0.84***	2.31
Cohort 8	0.77***	2.15	0.92***	2.51
Cohort 9	0.81***	2.26	1.03***	2.79
Cohort 10	1.05***	2.86	1.37***	3.92
Cohort 11	1.24***	3.47	1.51***	4.52
Enrollment	0.00***	1.00	0.00***	1.00
% Economically disadvantaged	0.25***	1.29	0.34***	1.41
% White	0.35**	1.43	−0.53***	0.59
% Black	−0.30**	0.74	0.08	1.09
% Hispanic	0.41**	1.50	−0.34***	0.71

OR = odds ratio.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Students with autism in rural schools performed slightly higher in ELA and mathematics, while students with mild, moderate, and severe ID performed significantly lower in rural schools. Overall, the results suggest significant heterogeneity between the disability categories and that being educated in rural settings has varied effects on different disability categories.

Discipline Outcomes

Differences in ISS and OSS for SWD in rural and urban schools. We estimated a series of generalized linear mixed-effects models to evaluate differences in ISS and OSS for SWD in rural and urban schools. Both ISS and OSS outcomes were dichotomous, therefore, we used a logit-link and the coefficients are reported as the log (odds ratio [OR]), which we converted to ORs. Table 4 presents the results for both ISS and OSS. Students with disabilities attending rural schools are less likely to receive ISS than SWD in urban schools. Yet, SWD in rural schools are more likely to receive an OSS than SWD in urban schools. The OR for both outcomes was not large, OR = 0.95 and OR = 1.04, respectively. Results also suggest that male SWD are significantly more likely than female SWD to receive both an ISS and OSS. Black and Hispanic SWD were also more likely than White SWD to receive an ISS or an OSS, with the largest effect size for Black SWD receiving OSS (OR = 1.39).

The results for time suggest that the odds of receiving an ISS or an OSS decreased across time. Congruent with the achievement models, we estimated an interaction effect for time and locale (i.e., rural or urban). The interaction terms in the second series of models were both positive and statistically significant. The interaction term OR for ISS was 1.03, log(OR) = 0.03, $p < .000$, and the interaction term OR for OSS was 1.01, log(OR) = 0.01, $p < .05$. The results

Table 5. Disability and Locale Mixed-Effects Models for Discipline Outcomes.

	In-school suspension		Out-of-school suspension	
Parameter	Log(OR)	OR	Log(OR)	OR
Intercept	−3.64***	0.03	−3.32***	0.04
Rural	−0.06*	0.94	0.04*	1.05
Emotional disturbance (ED)	−0.20***	0.82	0.41***	1.50
Other health impairment (OHI)	−0.01	0.99	0.11***	1.12
Speech–language impairment (SLI)	−0.59***	0.56	−0.74***	0.48
Autism (AU)	−0.92***	0.40	−0.40***	0.67
Deaf/blind (DB)	−1.22	0.30	−10.78	0.00
Developmental disability (DD)	−1.15***	0.32	−0.43***	0.65
Deaf (DF)	−0.12	0.88	−0.38	0.68
Hearing impairment (HI)	−0.44***	0.64	−0.21*	0.81
Intellectual disability—not defined (ID)	0.36***	1.43	0.13*	1.14
Intellectual disability—mild (IDMI)	−0.42***	0.66	−0.01	0.99
Intellectual disability—moderate (IDMO)	−1.74***	0.17	−0.32***	0.73
Intellectual disability—severe (IDSE)	−2.10***	0.12	−1.70***	0.18
Multiple disabilities (MU)	−1.64***	0.19	−1.21***	0.30
Orthopedic impairment (OI)	−0.97***	0.38	−0.93***	0.39
Traumatic brain injury (TB)	−0.38	0.68	−0.11	0.90
Visual impairment (VI)	−0.26	0.77	−0.43*	0.65
Rural × ED	−0.02	0.98	0.08	1.09
Rural × OHI	0.01	1.01	−0.02	0.98
Rural × SLI	−0.15*	0.86	0.03	1.03
Rural × AU	0.33***	1.39	0.21***	1.23
Rural × DB	0.53	1.70	10.10	>10
Rural × DD	0.23	1.26	0.07	1.07
Rural × DF	−1.55	0.21	0.49	1.64
Rural × HI	0.17	1.19	0.03	1.04
Rural × ID	−0.26**	0.77	0.01	1.01
Rural × IDMI	0.17**	1.18	−0.06	0.94
Rural × IDMO	0.45*	1.57	0.04	1.04
Rural × IDSE	−0.35	0.70	0.82*	2.26
Rural × MU	−0.07	0.93	0.06	1.06
Rural × OI	0.16	1.18	0.23	1.26
Rural × TB	0.02	1.02	−0.20	0.81
Rural × VI	−0.14	0.87	−0.09	0.92

OR = odds ratio.
*$p < .05$. **$p < .01$. ***$p < .001$.

suggest that the odds of receiving an ISS or an OSS for SWD in rural schools increase, while the odds decrease for SWD in urban schools.

Differences in ISS and OSS for Different Disability Categories in Rural and Urban Schools

Last, we estimated models with interactions between locale (e.g., urban or rural) and disability categories (see Table 5). A number of interesting patterns emerged. First, students with ED were less likely to receive an ISS than students with LD, but more likely to receive an OSS (OR = 1.50). No differences were found for the interaction, suggesting the locale was not a significant predictor of those differences between students with ED and LD. A similar pattern emerged for OSS for students with OHI, but the effect size was smaller (OR = 1.12). Two noteworthy differences by locale emerged. First, students with autism in rural settings were significantly more likely to receive ISS and OSS than peers in urban settings. Second, students in rural settings with severe ID were much more likely (OR = 2.26) to receive OSS than peers in urban schools.

Discussion

To date, limited quantitative, published research has specifically examined achievement and discipline outcomes for SWD in rural and urban settings. In this study, we leveraged a state-wide longitudinal data set of SWD and estimated locale differences focusing on rural and urban classifications and controlling for student- and school characteristics. Overall, we found statistically significant differences in reading, but not mathematics when comparing SWD in rural and urban schools. For discipline outcomes, we found that SWD in rural schools were less likely to receive ISS, but more likely to receive OSS. Overall, these results suggest that there are differences in achievement and discipline outcomes for SWD by setting, but the differences are dependent on the measure and the effect sizes are small.

Both SEELS and NAEP data suggest that SWD in rural schools perform higher than their peers in urban schools. However, North Carolina NAEP data suggest that there were no significant differences. The results of this study, which includes student- and school-covariate and adjusts for the nesting of students in schools, suggest that SWD in rural schools performed statistically significantly lower than SWD in urban schools in reading achievement. The discrepancies could be the result of including relevant covariates, leveraging longitudinal data, or educational issues specific to rural and urban schools in North Carolina. More analyses are needed to confirm the difference and, importantly, understand the discrepancies. There is no doubt that a large, longitudinal data set of school records does not adequately capture the unique nuances of each school and the instruction, pedagogy, and relationship building between teachers and students that increases the likelihood of student success. That being said, the significant difference suggests that SWD in rural schools may require higher quality or intensity of instruction for reading. This could be due to fewer highly qualified teachers, fewer financial resources, or myriad other differences between rural and urban schools (Berry et al., 2011).

A few interesting patterns also emerged when we compared the reading performance of students with different disabilities in rural and urban schools. First, students with ED performed significantly higher in reading than students with LD in urban schools. However, the pattern reversed in rural schools, with students with ED performing significantly lower than students with LD. This same pattern emerged for students with OHI and SLI, suggesting that students with LD in rural settings appeared to do slightly better in comparison to students with other, high incidence disability categories.

We found no significant differences in mathematics achievement for SWD between rural and urban achievements. Yet, when we included an interaction term between locale and disability category, a number of interesting patterns emerged. First, we found that students with LD and ED performed the same in mathematics in urban schools, but students with ED performed significantly lower than students with LD in rural schools. We also found that students with LD performed significantly lower than students with SLI in urban schools, but students with LD in rural schools performed higher than students with SLI. Perhaps the most dramatic and interesting finding was that students with LD performed significantly higher in mathematics than students with autism in urban schools, yet students with autism in rural schools performed higher in mathematics than students with LD. Since the pattern was the same for reading, there may, in fact, be differences in the types of students with autism in rural and urban schools. Given that Hott et al. (2020) found that IEPs for students with mathematics LD in rural schools appeared to be insufficient, the heterogeneity of mathematics patterns when compared with students with other disabilities suggest that (a) some rural schools are in fact meeting the mathematics needs of students with LD, (b) the lack of disaggregation of data by LD subtype (i.e., mathematics LD) is masking any true differences, or (c) IEPs for students with ED, OHI, and SLI are even less sufficient when it comes to mathematics intervention.

Results for students with more significant disabilities, such as ID, suggest significant achievement differences by locale. Students with mild, moderate, and severe ID all performed lower in rural schools. The ID group was students with ID in Cohort 1 only. The data set disaggregated ID into three types starting from 2008 to 2009. Thus, each subsequent year, the students' category reflected the severity of ID. Therefore, results for ID only reflect differences for that single year. That being said, the students with ID in rural schools did, in fact, perform better than those in urban schools, but those differences were no longer present in subsequent years. If we focus on the students with the most severe ID, we find that those that participated in the state reading and mathematics assessment in rural schools performed significantly lower than their peers in urban schools. Pennington et al. (2009) surveyed rural and urban teachers of students with severe disabilities and found that teachers in rural settings have fewer resources, both in school and in the community, and fewer special education personnel to serve similar numbers of students. These differences may have a concomitant effect on the academic performance of students with severe disabilities, but more research is needed.

The results for the discipline outcomes point to different patterns by type of suspension. The results suggest that SWD in rural schools are less likely to receive ISS but more likely to receive OSS. These differences could be due to limited ISS options in rural schools as there may be fewer staff to supervise ISS. As a result, it is possible that rural schools use OSS for behaviors that would result in an ISS in urban school. Unfortunately, we do not have information about the specific incident that led to the suspension and other disciplinary outcomes. More research is needed to evaluate what school-level factors are contributing to these differences.

With regards to differences by disability category, one of the largest effect sizes was for OSS of students with ED and LD. Students with ED are significantly more often given OSS, and there were no differences by locale. Unlike ED, students with autism and severe ID are much more likely to receive OSS in rural schools. The results for students with severe ID align with those of achievement, where it appears rural schools may not have enough qualified staff or resources to adequately support the needs of these students. The results for students with autism are also similar to achievement. The increased odds of suspension in rural schools, paired with the increased achievement, for students with autism suggests that there may be differences in the functioning level of those students in rural and urban schools. By functioning level, we mean differences for children with high functioning autism (i.e., typical cognitive development), and children with low-functioning autism (i.e., children with autism and cognitive impairment). However, a more nuanced analysis of students with autism in rural and urban settings is needed to confirm this hypothesis.

Limitations

All effort was made to implement and report a rigorous, high-quality analysis. Nonetheless, there are a number of important limitations. First, all data came from a single state in the Southeastern United States. As such, the results may not generalize to other, more rural/isolated settings, such as schools in remote Idaho, Montana, or North Dakota. Second, this study relied entirely on extant data reported to the state by local school personnel. There is no way to independently confirm the accuracy of the data. This is particularly relevant for suspension data as the measure is only of the discipline outcome and not the student behaviors. It is very likely that some behaviors in one school may lead to a suspension, while the same behavior in another school may not. Third, we used the vertical scores from the state achievement test, which is only given to students in Grades 4 to 8 and is likely not administered to all SWD. Data were available for students in all disability categories; therefore, accommodations of some type must have been given (e.g., Braille or verbal instruction for students with visual impairment). Fourth, we leveraged longitudinal data to increase the sample size, decrease the standard errors, and improve the accuracy of the estimates. That being said, we did not focus on differences in growth patterns but instead controlled for time and cohort. Future studies should consider examining growth and different patterns of growth (e.g., acceleration). Last, we only modeled disability category in an interaction model as we were primarily interested in differences by locale. Thus, we say much less about different patterns of achievement and discipline by different disability categories beyond locale.

Conclusion

Surprisingly, there have not been many rigorous quantitative studies specifically examining differences in achievement and discipline outcomes for SWD in rural and urban schools. This study was designed to address this gap in the literature by leveraging a longitudinal statewide data set of SWD. Overall, we found several differences between rural and urban schools, notably, lower reading achievement, fewer ISS, and more OSS in rural schools. Interesting patterns also emerged for students with specific disabilities. Overall, these results are a starting point to begin more detailed, fine-grained analyses to better understand the experiences of SWD in rural and urban schools to better be able to explain and, eventually improve, the differences in rural and urban schools.

Declaration of Conflicting Interests

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References

Achilles, G. M., Mclaughlin, M. J., & Croninger, R. G. (2007). Sociocultural correlates of disciplinary exclusion among students with emotional, behavioral, and learning disabilities in the SEELS national dataset. *Journal of Emotional and Behavioral Disorders*, *15*(1), 33–45. https://doi.org/10.1177/10634266070150010401

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1), 1–48. https://doi.org/10.18637/jss.v067.i01

Berry, A. B., Petrin, R. A., Gravelle, M. L., & Farmer, T. W. (2011). Issues in special education teacher recruitment, retention, and professional development: Considerations in supporting rural teachers. *Rural Special Education Quarterly*, *30*(4), 3–11. https://doi.org/10.1177/875687051103000402

Cholewa, B., Hull, M. F., Babcock, C. R., & Smith, A. D. (2018). Predictors and academic outcomes associated with in-school suspension. *School Psychology Quarterly*, *33*(2), 191–199. https://doi.org/10.1037/spq0000213

Edington, E. D., & Koehler, L. (1987). *Rural student achievement: Elements for consideration* (ERIC Document Reproduction Service No. ED 289-685). New Mexico State University.

Fan, X., & Chen, M. J. (1999). Academic achievement of rural school students: A multi-year comparison with their peers in suburban and urban schools. *Journal of Research in Rural Education*, *15*(1), 31–46.

Gage, N. A., Katsiyannis, A., Carrero, K. M., Miller, R., & Pico, D. (2020). Exploring disproportionate discipline for Latinx students with and without disabilities: A national analysis. *Behavioral Disorders*, *47*(1), 3–13. https://doi.org/10.1177/0198742920961356

Gage, N. A., Whitford, D. K., Katsiyannis, A., Adams, S., & Jasper, A. (2019). National analysis of the disciplinary exclusion of black students with and without disabilities. *Journal of Child and Family Studies*, *28*, 1754–1764. https://doi.org/10.1007/s10826-019-01407-7

Geverdt, D. (2015). *Education demographic and geographic estimates program (EDGE): Locale boundaries user's manual* (NCES 2016-012). U.S. Department of Education. National Center for Education Statistics. http://nces.ed.gov/pubsearch

Gilmour, A. F., Fuchs, D., & Wehby, J. H. (2019). Are students with disabilities accessing the curriculum? A meta-analysis of the reading achievement gap between students with and without disabilities. *Exceptional Children*, *85*(3), 329–346. https://doi.org/10.1177/0014402918795830

Hott, B. L., Morano, S., Peltier, C., Pulos, J., & Peltier, T. (2020). Are students with mathematics learning disabilities receiving FAPE? Insights from a descriptive review of individualized education programs. *Learning Disabilities Research & Practice*, *35*(4), 170–179. https://doi.org/10.1111/ldrp.12231

Mbella, K., Zhu, M., Karkee, T., & Lung, H., & North Carolina Department of Public Instruction. (2016a). *The North Carolina testing program technical report 2012-2015 English language arts/reading assessments (ELA) end-of grade 3-8 and end-of-course English II*. Public Schools of North Carolina, State Board of Education, Department of Public Instruction. https://files.nc.gov/dpi/documents/files/technical-report-2012-2015-ela-eog-3-8-and-eoc-english-ii.pdf

Mbella, K., Zhu, M., Karkee, T., & Lung, H., & North Carolina Department of Public Instruction. (2016b). *The North Carolina testing program technical report 2012-2015 mathematic assessments end-of grade 3-8 and end-of-course Math I*. Public Schools of North Carolina, State Board of Education, Department of Public Instruction. https://files.nc.gov/dpi/documents/accountability/testing/technotes/mathtechreport1215.pdf

Morgan, P. L., Farkas, G., Hillemeier, M. M., Wang, Y., Mandel, Z., DeJarnett, C., & Maczuga, S. (2019). Are students with disabilities suspended more frequently than otherwise similar students without disabilities? *Journal of School Psychology*, *72*, 1–13. https://doi.org/10.1016/j.jsp.2018.11.001

Noltemeyer, A., & Mcloughlin, C. S. (2010). Patterns of exclusionary discipline by school typology, ethnicity, and their interaction. *Penn GSE Perspectives on Urban Education*, *7*(1), 27–40. https://files.eric.ed.gov/fulltext/EJ894465.pdf

Pennington, R., Horn, C., & Berrong, A. (2009). An evaluation of the differences between big city and small town special education services for students with low incidence disabilities in Kentucky. *Rural Special Education Quarterly*, *28*(4), 3–9. https://doi.org/10.1177/875687050902800402

R Core Team. (2017). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.r-project.org/

Stevens, J. J., Schulte, A. C., Elliott, S. N., Nese, J. F., & Tindal, G. (2015). Growth and gaps in mathematics achievement of students with and without disabilities on a statewide achievement test. *Journal of School Psychology*, *53*(1), 45–62. https://doi.org/10.1016/j.jsp.2014.11.001

Sullivan, A. L., Klingbeil, D. A., & Van Norman, E. R. (2013). Beyond Behavior: Multilevel analysis of the influence of sociodemographics and school characteristics on students' risk of suspension. *School Psychology Review*, *42*, 99–114. https://doi.org/10.1177/1063426610377329

U.S. Department of Education, Institute of Education Science, National Center for Education Statistics. (2020). *Rural education in American*. https://nces.ed.gov/surveys/ruraled/students.asp

U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. (2022a). National Assessment of Educational Progress (NAEP), various years, 1992–2019. Reading Assessments. https://www.nationsreportcard.gov/reading/?grade=4

U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics. (2022b). National Assessment of Educational Progress (NAEP), various years, 1990–2019. Mathematics Assessments. https://www.nationsreportcard.gov/mathematics/?grade=4

U.S. Department of Education, Safe and Supportive Learning. (2020). *North Carolina compilation of school discipline laws and regulations*. https://safesupportivelearning.ed.gov/sites/default/files/discipline-compendium/North%20Carolina%20School%20Discipline%20Laws%20and%20Regulations.pdf

U.S. General Accountability Office. (2018). *K-12 education: Discipline disparities for Black students, boys, and students with disabilities*. https://www.gao.gov/products/GAO-18-258

Wei, X., Blackorby, J., & Schiller, E. (2011). Growth in reading achievement of students with disabilities, ages 7 to 17. *Exceptional Children*, *78*(1), 89–106. https://doi.org/10.1177/001440291107800106

Wei, X., Lenz, K. B., & Blackorby, J. (2013). Math growth Trajectories of students with disabilities: Disability category, gender, racial, and socioeconomic status differences from ages 7 to 17. *Remedial and Special Education*, *34*(3), 154–165. https://doi.org/10.1177/0741932512448253

Woodcock, N., McGrew, K. S., & Mather, K. S. (2001). *Woodcock-Johnson III Test Manual (III)*. Riverside.

Zablotsky, B., Black, L. I., Maenner, M. J., Schieve, L. A., Danielson, M. L., Bitsko, R. H., . . . Boyle, C. A. (2019). Prevalence and trends of developmental disabilities among children in the United States: 2009–2017. *Pediatrics*, *144*(4), Article e20190811. https://doi.org/10.1542/peds.2019-0811

Zhao, G., Okoro, C. A., Hsia, J., Garvin, W. S., & Town, M. (2019). Prevalence of disability and disability types by urban-rural county classification—U.S. 2016. *American Journal of Preventive Medicine*, *57*(6), 749–756. https://doi.org/10.1016/j.amepre.2019.07.022