# **Understanding Nebraska's ACT Scores During the COVID-19 Pandemic**

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### Introduction

The COVID-19 pandemic caused widespread disruptions to the educational system in Nebraska and across the world. At the onset of the pandemic in March 2020, schools in Nebraska were forced to replace on-site instruction with virtual instruction. During the 2020–2021 academic year, many students learned online or under hybrid learning formats.

Nebraska administers the ACT® test statewide in the spring of 11th grade. Testing was canceled in spring 2020, a makeup test was offered in fall 2020, and 11th-grade testing resumed in spring 2021. The research summarized in this paper examines impacts of the pandemic on student performance on Nebraska's statewide administrations of the ACT test. We compare performance in spring 2017–2019 (before the pandemic) to performance in fall 2020 and spring 2021 (during the pandemic) and account for changes in the tested population across years. We address the following research questions:

- 1. How were Nebraska's ACT test scores impacted by the COVID-19 pandemic?
- 2. Did the pandemic's impact on ACT test scores vary for different student groups?
- 3. Was the pandemic's impact on ACT test scores worse for communities with greater social vulnerability?
- 4. Was the pandemic's impact on ACT test scores worse for communities with higher COVID-19 case rates?

### Data

ACT test scores and student demographic data were provided by the Nebraska Department of Education for the 11th-grade cohorts of 2017 through 2021. The data included ACT section test scores and ACT Composite scores, eligibility for free or reduced-price meals, participation in English learner programs, special education status, gender, race/ethnicity, and school name.

From the Centers for Disease Control (CDC), we obtained community-wide data measuring social vulnerability and COVID-19 case rates. The Social Vulnerability Index (SVI) includes scores for four themes (Socioeconomic, Household Composition & Disability, Minority Status &



Language, and Housing Type & Transportation) as well as an overall measure based on the variables forming the four themes. The SVI is designed to measure a community's ability to prevent human suffering and financial loss in the event of disaster, based on several social conditions present in the community (CDC & ATSDR, 2018). The SVI scores are percentile rankings ranging from 0 to 1, with higher values indicating greater vulnerability. COVID-19 case rates were calculated for each county using the CDC's COVID-19 Case Surveillance Restricted Access Detailed Data (CDC, 2021). The CDC data were merged with the analysis data set using the school's county FIPS (Federal Information Processing System) code.

### **Methods**

# Sample and Weighting

To be included in the analysis, students must have had at least one ACT section test score and all demographic variables (eligibility for free or reduced-price meals, participation in English learner programs, special education status, gender, and race/ethnicity). Analysis was conducted for each test section (English, mathematics, reading, and science, each on a 1–36 scale), as well as for Composite (also on a 1–36 scale). The English and reading scores were summed to form an overall measure for English language arts (on a 2–72 scale).

Table 1 shows the sample size by year for each student group for the analysis of Composite scores. (The sample sizes for the section test scores are slightly higher). Table 1 also shows the percentage of students belonging to each group for each year. Relative to the pre-pandemic years, fewer students who are in special education, who are African American, and who are Native American or Native Hawaiian participated in ACT testing in 2020.



Table 1. Sample Size and Percentage Belonging to Each Group, by Student Group and Year

Cuarra	Sample Size for Analysis of Composite Scores							
Group	2017	2018	2019	2020	2021			
Total	21,580	21,803	22,209	18,936	21,600			
Female	10,570	10,748	10,950	9,470	10,596			
	(49.0%)	(49.3%)	(49.3%)	(50.0%)	(49.1%)			
Male	11,010	11,055	11,259	9,466	11,004			
	(51.0%)	(50.7%)	(50.7%)	(50.0%)	(50.9%)			
African American	1,315	1,402	1,316	1,004	1,157			
	(6.1%)	(6.4%)	(5.9%)	(5.3%)	(5.4%)			
Asian	509	568	600	519	585			
	(2.4%)	(2.6%)	(2.7%)	(2.7%)	(2.7%)			
Hispanic	3,725	3,851	4,180	3,270	3,982			
	(17.3%)	(17.7%)	(18.8%)	(17.3%)	(18.4%)			
Native American/Hawaiian	286	306	248	187	251			
	(1.3%)	(1.4%)	(1.1%)	(1.0%)	(1.2%)			
Two or more races	637	618	705	586	708			
	(3.0%)	(2.8%)	(3.2%)	(3.1%)	(3.3%)			
White	15,108	15,058	15,160	13,370	14,917			
	(70.0%)	(69.1%)	(68.3%)	(70.6%)	(69.1%)			
Special education	2,383	2,472	2,524	1,853	2,259			
	(11.0%)	(11.3%)	(11.4%)	(9.8%)	(10.5%)			
Free/reduced-price lunch eligible	8,547	8,727	9,090	7,328	8,442			
	(39.6%)	(40.0%)	(40.9%)	(38.7%)	(39.1%)			
English learner	616	699	917	604	794			
	(2.9%)	(3.2%)	(4.1%)	(3.2%)	(3.7%)			

To ensure that the five cohorts were similar in terms of demographic characteristics, we used propensity score weighting (Austin, 2011) to weight each group to be similar to the pooled data set, which combines the data across the five cohorts. The procedure uses logistic regression to estimate each student's propensity for being in each cohort based on their gender, race/ethnicity, special education status, free/reduced-price lunch status, and English learner status.

### **Statistical Models**

Using the weighted data, we fit hierarchical linear regression models in order to estimate the adjusted difference in average test scores across years for each section test, the Composite score, and the English language arts measure. The models included a random intercept for the school effect and included the same covariates that were used for the propensity score weighting model. The general form of the regression model was

test score = cohort year + covariates + school effect.



The model is a special case of an analysis of covariance (ANCOVA) model where cohort year is the categorical variable of interest. From the model, we estimated the COVID-19 impact for the 2020 cohort as  $\mu_{2020} - \frac{\mu_{2017} + \mu_{2018} + \mu_{2019}}{3}$ , where  $\mu_{Year}$  is the estimated adjusted mean ACT test score for the year. Similarly, we estimated the COVID-19 impact for the 2021 cohort as  $\mu_{2021} - \frac{\mu_{2017} + \mu_{2018} + \mu_{2019}}{3}$ . Therefore, the COVID-19 impact is measured as the adjusted mean ACT score for each pandemic year relative to the average over the three most recent pre-pandemic years. We refer to the estimates of the COVID-19 impact as the **adjusted score difference**. The adjusted score difference can be expressed on the original test score scale and in standard deviation units (d = adjusted score difference divided by the standard deviation of the test score).

The hierarchical linear regression models were also used to estimate the adjusted score differences for different student groups, including

- male and female;
- racial/ethnic groups: African American, Asian, Hispanic, Native American/Native Hawaiian, White, and two or more races;
- students in special education and students not in special education;
- students who are from low-income households and students who are not from low-income households (as determined by free/reduced-price lunch eligibility); and
- students who are English learners (ELs) and students who are not ELs.

Group-specific estimates were obtained by fitting the hierarchical linear regression model with interactions between the cohort (year) and the group indicator.

To test whether school- and county-level continuous variables were associated with ACT score declines, we fit the hierarchical linear regression model with interactions between the cohort (year) indicator and each continuous variable. The continuous variables included

- school percentage eligible for free or reduced-price lunch;
- school percentage in traditionally underserved racial/ethnic groups (African American, Hispanic, Native American/Native Hawaiian, two or more races);
- school percentage African American;
- school percentage Hispanic;



- county Social Vulnerability Indices (SVIs), including scores for the Socioeconomic theme, Household Composition & Disability theme, Minority Status & Language theme, Housing Type & Transportation theme, and Overall; and
- county COVID-19 case rates, including the total from March 2020 to March 2021 and the youth-specific rate from March 2020 to March 2021. For the 2021 cohort, we also examined the total rate from September 2020 to March 2021 and the youth-specific rate from September 2020 to March 2021.

# **Adjustment for Fall 2020 Testing**

Because the 2020 cohort tested in fall 2020 (12th grade) rather than spring 2020 (11th grade), the average ACT scores for the 2020 cohort may have been influenced by testing later in addition to the effects of the schooling disruptions. Therefore, in order to compare the fall 2020 test scores to the pre-pandemic test scores, we must account for academic growth that normally occurs from the spring of 11th grade (late March) to the fall of 12th grade (late September).

Using data from Nebraska's 11th-grade cohorts of 2017, 2018, and 2019, we estimated the average pre-pandemic gain in ACT scores for a sample of 17,125 students who took the statewide ACT test in the spring of 11th grade and again five to seven months later in the fall of 12th grade. We used propensity score weighting to weight the sample to be similar to Nebraska's population of 11th-grade ACT state test examinees from 2017 to 2019. The procedure uses logistic regression to estimate each student's propensity for being in the retest sample based on their gender, race/ethnicity, high school's average ACT Composite score, and high school enrollment size. After weighting, we calculated the sample's average gain in ACT scores (Table 2).

Table 2. Nebraska's Average Spring Grade 11 to Fall Grade 12 ACT Score Gain, 2017–2019

ACT Score	Average Gain
Composite	0.53
English	0.88
English + reading	1.60
Math	0.13
Reading	0.72
Science	0.35

**Note**: English + reading scores are on a 2–72 scale, while the other test scores are on a 1–36 scale.

The average gains in Table 2 represent how much students' scores are expected to increase when students test in the fall of 12th grade rather than the spring of 11th grade. Note that the average gains are small because of summer learning loss, particularly for math (Allen, Mattern, & Camara, 2020). Later in this paper, the average gains will be used to adjust the estimates of the pandemic-related score declines for the 2020 cohort.



### **Results**

# **Total Group ACT Score Changes**

The adjusted score differences provide an overall estimate of the pandemic's impact on ACT test scores. Table 3 provides the estimated score declines for 2020 for each ACT score. The table shows the average ACT score for the pre-pandemic years (2017–2019), the average score for 2020, the raw difference, and the adjusted difference. The adjusted difference incorporates the sample weighting and ANCOVA regression model and represents the estimate of the pandemic's impact on ACT test scores. For the 2020 cohort, the adjusted score difference also incorporates the adjustments for fall testing (Table 2). For example, the weighted ANCOVA model estimated that Composite scores were 0.12 score points lower for the fall-tested 2020 cohort relative to the pre-pandemic spring-tested cohorts (2017–2019). Because the average pre-pandemic Composite gain from spring to fall is 0.53 score points (Table 2), the adjusted score difference is -0.65 (-0.12 -0.53 = -0.65). Table 3 also includes the standard error of the adjusted score difference and the standardized effect size measure (d).

Table 3. Average ACT Score Changes for 2020 Cohort

	Average Score						
ACT Score	2017– 2019	2020	Diff.	Adj. Diff.	SE Adj. Diff.	d	
Composite	19.35	19.45	0.09	-0.65	0.04	-0.12	
English	18.43	18.27	-0.16	-1.29	0.04	-0.20	
English + reading	37.96	38.33	0.37	-1.69	0.08	-0.14	
Math	19.37	19.16	-0.21	-0.53	0.04	-0.11	
Reading	19.53	20.06	0.53	-0.39	0.05	-0.06	
Science	19.59	19.79	0.20	-0.35	0.04	-0.07	

**Note**: Diff. = difference, Adj. = adjusted, SE = standard error, *d* = adjusted difference in standard deviation units



 Table 4. Average ACT Score Changes for 2021 Cohort

	Average Score					
ACT Score	2017– 2019	2021	Diff.	Adj. Diff.	SE Adj. Diff.	d
Composite	19.35	18.84	-0.51	-0.64	0.03	-0.12
English	18.43	17.60	-0.83	-0.98	0.04	-0.15
English + reading	37.96	36.74	-1.22	-1.49	0.08	-0.12
Math	19.37	18.81	-0.56	-0.69	0.03	-0.14
Reading	19.53	19.14	-0.39	-0.51	0.04	-0.08
Science	19.59	19.10	-0.49	-0.61	0.04	-0.12

**Note**: Diff. = difference, Adj. = adjusted, SE = standard error, *d* = adjusted difference in standard deviation units

Table 4 provides the estimated score declines for the 2021 cohort. The Composite score declines for the 2020 and 2021 cohorts were similar (-0.65 and -0.64, respectively). The English score decline for the 2020 cohort (-1.29) was more severe than the English score decline for the 2021 cohort (-0.98), while the score declines for math, reading, and science were more severe for the 2021 cohort. Expressed in standard deviation units, the ACT score declines were largest for English (d = -0.20 for the 2020 cohort and d = -0.15 for the 2021 cohort) and smallest for reading (d = -0.06 for the 2020 cohort and d = -0.08 for the 2021 cohort). The results show that academic achievement, as measured by the ACT test, declined during the pandemic.

# **ACT Composite Score Declines by Student Group**

The decline in ACT test scores was also examined for each student group. Table 5 reports the results for the analysis of Composite scores for the 2020 cohort. The decline in ACT Composite scores was largest for Native American and Native Hawaiian students (d = -0.20). This group had a relatively small sample size (n = 187 for the 2020 cohort) and so is more likely to have had larger score fluctuations. The decline for Native American/Native Hawaiian students was not significantly different from the decline for White students (d = -0.14). The decline in ACT Composite scores was least severe for Asian students (d = 0.02, indicating that ACT scores increased for the 2020 cohort relative to the pre-pandemic cohorts) and multiracial students (d = -0.01). The decline was more severe for students who are not English learners (d = -0.13) relative to students who are English learners (d = -0.06), though the difference was not statistically significant. For the 2020 cohort, score declines were similar by gender, free/reduced-price lunch eligibility, and special education status. The decline in ACT Composite scores was similar for African American (d = -0.12), Hispanic (d = -0.11), and White (d = -0.14) students.



Table 5. Average ACT Composite Score Changes for the 2020 Cohort, by Student Group

	Average Composite Score					
Student Group	2017– 2019	2020	Diff.	Adj. Diff.	SE Adj. Diff.	d
Female	19.61	19.58	-0.03	-0.69	0.05	-0.13
Male	19.11	19.31	0.21	-0.60	0.05	-0.11
African American	15.56	15.74	0.18	-0.65	0.15	-0.12
Asian	19.73	20.87	1.14	0.08	0.22	0.02
Hispanic	16.49	16.47	-0.02	-0.59	0.09	-0.11
Native Am./Hawaiian	15.88	16.11	0.23	-1.03	0.33	-0.20
Two or more races	18.69	19.45	0.75	-0.07	0.21	-0.01
White	20.51	20.44	-0.07	-0.71	0.04	-0.14
Special education	14.89	14.91	0.03	-0.51	0.11	-0.10
Not special education	19.92	19.94	0.02	-0.66	0.04	-0.13
Free/reduced-price lunch	16.86	17.01	0.15	-0.60	0.06	-0.11
No free/reduced-price lunch	21.03	20.99	-0.04	-0.68	0.05	-0.13
English learner	13.12	13.29	0.17	-0.29	0.20	-0.06
Not English learner	19.57	19.65	0.08	-0.66	0.04	-0.13

**Note**: Diff. = difference, Adj. = adjusted, SE = standard error, *d* = adjusted difference in standard deviation units

Table 6 reports the same results for the 2021 cohort. The decline in ACT Composite scores was largest for African American students (d = -0.17), though the decline for African American students was not significantly different from the decline for White students (d = -0.12). The decline in ACT Composite scores was least severe for students who are English learners (d = 0.00) and students who are Native American or Native Hawaiian (d = -0.02). For the 2021 cohort, score declines were similar by gender, race/ethnicity, free/reduced-price lunch eligibility, and special education status. Similar to what was observed for the 2020 cohort, the decline in ACT Composite scores was similar for African American (d = -0.17), Hispanic (d = -0.13), and White (d = -0.12) students.

While the results for each student group are not entirely consistent across the two cohorts, we found that the Composite score declines were mostly similar across different student groups. For example, for Asian students, ACT Composite scores did not decline for the 2020 cohort but declined by 0.12 standard deviations for the 2021 cohort. For both cohorts, we found that score declines were less severe for students who are English learners relative to students who are not English learners.



Table 6. Average ACT Composite Score Changes for the 2021 Cohort, by Student Group

	Average Composite Score					
Student Group	2017– 2019	2021	Diff.	Adj. Diff.	SE Adj. Diff.	d
Female	19.61	19.09	-0.52	-0.62	0.05	-0.12
Male	19.11	18.60	-0.51	-0.66	0.05	-0.13
Asian	19.73	19.59	-0.14	-0.64	0.21	-0.12
African American	15.56	14.86	-0.70	-0.87	0.14	-0.17
Hispanic	16.49	15.88	-0.61	-0.68	0.08	-0.13
Native Am./Hawaiian	15.88	15.84	-0.05	-0.11	0.31	-0.02
Two or more races	18.69	18.25	-0.44	-0.67	0.20	-0.13
White	20.51	19.99	-0.52	-0.62	0.04	-0.12
Special education	14.89	14.37	-0.51	-0.57	0.10	-0.11
Not special education	19.92	19.36	-0.56	-0.65	0.04	-0.12
Free/reduced-price lunch	16.86	16.34	-0.52	-0.64	0.05	-0.12
No free/reduced-price lunch	21.03	20.45	-0.59	-0.65	0.04	-0.12
English learner	13.12	12.96	-0.15	0.00	0.19	0.00
Not English learner	19.57	19.06	-0.51	-0.67	0.04	-0.13

**Note**: Diff. = difference, Adj. = adjusted, SE = standard error, *d* = adjusted difference in standard deviation units

# ACT Composite Score Declines by School and County Variables

Table 7 summarizes the analyses examining whether ACT Composite score declines were associated with school- and county-level variables. For each cohort, the table provides the estimated regression coefficient (EST) for the interaction term for each variable, as well as the cohort indicator, the standard error of the estimated regression coefficient (SE), and its p-value (p-val). Results are considered statistically significant if the p-value for the interaction coefficient is below .05.

For the 2021 cohort, school percentage African American was associated with larger ACT score declines (EST = -0.771 and p-value = .042). This suggests that schools in Nebraska serving more African American students had larger ACT score declines during the pandemic. However, for the 2020 cohort, the result was much different (EST = 0.788 and p-value = .055), suggesting that Nebraska schools serving more African American students had smaller ACT score declines.



For the 2021 cohort, county-level measures of social vulnerability were associated with the severity of ACT Composite score declines. The strongest association was observed for the SVI Housing Type & Transportation theme (EST = -0.504 and p-val < .001). Other significant associations were observed for the SVI Minority Status & Language theme (EST = -0.419) and the overall SVI (EST = -0.428). For the 2020 cohort, the SVI Household Composition & Disability theme was associated with larger ACT Composite score declines (EST = -0.501 and p-val = .003).

County overall COVID-19 case rate was associated with more severe ACT Composite score declines (EST = -4.352 and p-val = .027) for the 2020 cohort, but it was associated with less severe ACT Composite score declines (EST = 5.553 and p-val = .003) for the 2021 cohort. County COVID-19 case rates during the 2020–2021 school year (i.e., from September 2020 to March 2021) were associated with less severe ACT Composite score declines for the 2021 cohort. This was also the case for the youth-specific case rate.

**Table 7**. Average ACT Composite Score Changes for 2020 and 2021 Cohorts, by School- and County-Level Characteristics

Variable	20	20 Coho	rt	20:	2021 Cohort		
Variable	EST	SE	<i>p</i> -val	EST	SE	<i>p</i> -val	
School % FRL	0.170	0.175	.331	-0.185	0.165	.264	
School % Underserved Racial/Ethnic Groups	0.248	0.152	.103	-0.239	0.145	.100	
School % African American	0.788	0.410	.055	-0.771	0.379	.042	
School % Hispanic	0.259	0.180	.150	-0.154	0.174	.375	
County SVI: Socioeconomic	-0.475	0.246	.053	-0.179	0.232	.440	
County SVI: Household Composition & Disability	-0.501	0.167	.003	0.058	0.162	.719	
County SVI: Minority Status & Language	0.160	0.143	.264	-0.419	0.137	.002	
County SVI: Housing Type & Transportation	0.146	0.144	.311	-0.504	0.138	.000	
County SVI: Overall	-0.179	0.179	.317	-0.428	0.171	.012	
County COVID-19 Case Rate: Total	-4.352	1.963	.027	5.553	1.888	.003	
County COVID-19 Case Rate: Youth	0.462	3.500	.895	5.330	3.363	.113	
County COVID-19 Case Rate: Total since Sep. 2020	_	_	_	7.792	2.316	.001	
County COVID-19 Case Rate: Youth since Sep. 2020		_		8.320	3.736	.026	

**Note**: EST = estimate, SE = standard error, FRL = free or reduced-price lunch, SVI = Social Vulnerability Index



### **Discussion**

# **Revisiting the Research Questions**

ACT test scores from Nebraska's statewide testing program declined during the pandemic years of 2020 and 2021. The analysis adjusted for changes in the tested population across years. For the 2020 cohort, the analysis also adjusted for testing in the fall of 12th grade rather than the spring of 11th grade. Because of the adjustments, the declines in average ACT scores are not attributed to changes in the tested population, which suggests that they can be attributed to the pandemic.

The decline in ACT Composite scores was consistent for the two pandemic cohorts, with scores declining by 0.65 points for the 2020 cohort and by 0.64 points for the 2021 cohort. For both cohorts, the score decline was most severe for English and least severe for reading and science. Prior research suggests that while in school, students show larger gains in ACT English scores relative to ACT reading and science scores (Allen et al., 2020). This suggests that ACT English scores are more sensitive to instruction, and therefore larger score declines may be expected for English after disrupted instruction (e.g., school closures).

Generally, the size of the ACT Composite score declines was similar across different student groups. While some differences were observed across student groups, the differences usually did not replicate across cohorts. However, for both cohorts, we found that the score decline was less severe for students who are English learners relative to students who are not English learners.

We tried to identify results that were consistent across the two pandemic cohorts. Some of the county-level measures of social vulnerability were related to ACT Composite score declines, but the results were not consistent across the two cohorts. For the 2021 cohort, county-level social vulnerability related to housing type and transportation was associated with more severe ACT Composite score declines. But for the 2020 cohort, the association was not statistically significant.

County-level measures of COVID-19 case rates were associated with ACT Composite score declines in some cases, but the results were not consistent across cohorts. For the 2021 cohort, counties with higher COVID-19 case rates tended to have less severe ACT Composite score declines.

# **Study Limitations**

While the study found that ACT scores declined during the pandemic, it did not examine whether the score declines varied by mode of instruction (on-site, virtual, or hybrid). With additional data collection planned for spring 2022, it may be possible to examine performance by mode of instruction.



The study examined the relationship between ACT score declines and several demographic, school-level, and county-level variables. The analysis was exploratory and correlational in nature and does not suggest that differences in the variables examined caused changes in the response to the pandemic. Further, individual students' pandemic responses may not have been sensitive to county-level social vulnerability and COVID-19 case rates, so the analyses may have lacked power to detect meaningful associations between individual social vulnerability and academic performance.

The 2020 cohort tested in the fall of 12th grade rather than the spring of 11th grade. We adjusted for time of testing using the average gains that are normally observed from spring to fall. This approach assumes that the average gains are reliably estimated and are the same for all student groups. However, it is possible that the increase in scores from spring to fall is due, in part, to the practice effects of taking the ACT test multiple times. If this were the case, we would expect the fall Grade 12 scores to be somewhat lower for first-time examinees. Therefore, there is greater uncertainty about the results for the 2020 cohort.

### Conclusion

Because they have the same meaning across years and are predictive of college and career success, ACT scores are useful indicators of academic progress. As states face the challenges of the pandemic and its aftermath, ACT scores can help us understand how much student learning and preparation for college and careers have been impacted. Data from Nebraska's ACT testing program suggest that the Composite score declines are comparable to about three months of lost instruction. By continuing to monitor ACT scores, we can better understand whether the loss in achievement will persist for future cohorts.

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#### **Notes**



<sup>&</sup>lt;sup>1</sup> The CDC does not take responsibility for the scientific validity or accuracy of the methodology, results, statistical analyses, or conclusions presented in this paper.



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