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Feeding the Gap: Evaluating the Impact of Michigan's School Meals Program on Student Achievement

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Abstract

Persistent disparities in access to nutritious food and their effects on student learning remain a major challenge in U.S. public education, yet the short-term academic impacts of statewide universal school-meal policies are not well understood. Michigan's 2023–2024 School Meals Program—which provides free breakfast and lunch to all public-school students—offers a critical opportunity to assess whether broadening meal access can help reduce achievement gaps across socioeconomic groups. This study examined the relationship between food insecurity and student academic performance in Michigan public schools, focusing on the impact of the 2023–2024 Michigan School Meals program. Using data from over 500 districts, fifth-grade M-STEP, eighth-grade PSAT, and eleventh-grade SAT results were analyzed across socioeconomic groups. Descriptive analyses revealed strong negative correlations between food insecurity indicators and academic achievement. Boxplots showed modest improvements in test scores post-policy for both disadvantaged and advantaged students. However, difference-in-differences regression found limited evidence of short-term causal impact. The interaction term capturing policy effects for disadvantaged students was positive but statistically significant only in select grade levels. Overall, while universal meal access may contribute to small academic gains, particularly for disadvantaged students, its effects appeared modest in the first year. Further research is needed to assess longer-term educational and equity outcomes.

Keywords: Educational equity, Michigan school meal program, Food insecurity and student achievement, Socioeconomic status and test performance, Difference-in-difference (DID) analysis, Policy impacts on disadvantaged students

1. Introduction

Food insecurity remains a persistent barrier to educational equity in the United States. Defined as limited or uncertain access to adequate food, food insecurity has been associated with lower academic performance, higher rates of absenteeism, and increased behavioral and emotional problems among school-aged children (Gundersen & Ziliak, 2015). Schools have long served as critical sites of nutritional intervention, particularly through federally subsidized meal programs. However, these programs have traditionally been means-tested, targeting only students from low-income families, often creating stigma and leaving gaps in access for borderline or undocumented populations.

In recent years, several states have experimented with universal free school meal policies aimed at eliminating eligibility barriers and increasing participation. Michigan joined this movement in the 2023–2024 academic year with the launch of the Michigan School Meals program, providing free breakfast and lunch to all public school students regardless of income. Despite growing interest in universal school-meal policies, there is limited evidence on whether statewide programs meaningfully influence academic achievement, particularly in mixed-income states where socioeconomic disparities remain substantial. Michigan's recent transition to free meals for all students provides a valuable natural policy experiment, but the short-term academic consequences of this expansion have not yet been empirically assessed. Accordingly, this research tried to answer the question: To what extent did the 2023–2024

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Michigan School Meals Program affect student academic outcomes, and did economically disadvantaged students benefit disproportionately relative to their more advantaged peers?

This paper presented a two-part empirical analysis leveraging publicly available data from Michigan public school districts. The first part quantified the relationship between food insecurity indicators—including FRPL (Free and Reduced-Price Lunch) eligibility rates and adult educational attainment—and student academic performance as measured by standardized test pass rates. The second part useed a difference-in-differences (DID) framework with interaction terms to evaluate the impact of Michigan's universal meal policy on academic outcomes, with particular focus on differential effects for economically disadvantaged versus advantaged students.

By combining descriptive and causal approaches, this research aimed to provide evidence on both the long-standing structural links between poverty and learning, and the short-term equity impacts of universal school meal provision.

2. Literature Review

A robust body of research has documented the associations between food insecurity and academic outcomes in school-aged children. Food-insecure students are more likely to experience difficulties in concentration, lower academic achievement, and behavioral problems (Jyoti et al., 2005). These effects are compounded in high-poverty communities, where limited access to nutritious food may coexist with other systemic barriers to learning, such as housing instability, chronic absenteeism, and under-resourced schools (Basch, 2011).

Traditional school meal programs, such as the National School Lunch Program (NSLP) and School Breakfast Program (SBP), have been found to positively influence student outcomes. Participation in these programs is associated with improved dietary intake (Gleason & Suitor, 2003), lower BMI among low-income students (Levine, 2011), and better performance on standardized assessments (Bartfeld & Ahn, 2011). However, these means-tested programs can also introduce administrative burdens and social stigma, potentially deterring participation among eligible students (Moore et al., 2022).

Recent attention has shifted to the impact of universal free meal policies. The Community Eligibility Provision (CEP), a federal option enabling schools with high poverty concentrations to serve free meals to all students, has been associated with increased participation, improved attendance, and modest gains in academic performance (Leos-Urbel, 2015; Ruffini, 2021). Studies of statewide universal meal expansions in California and Maine suggest that making school meals free for all students can improve food security and school engagement without negatively affecting meal program finances (Schanzenbach & Zaki, 2020).

While these studies underscore the potential of universal school meals to mitigate food insecurity and support learning, less is known about their short-term academic effects across different socioeconomic groups within a mixed-eligibility state like Michigan. This research contributes to the literature by analyzing not only statewide trends but also how program impacts may vary between economically disadvantaged and advantaged student populations.

3. Data and Methodology

This study drew on district-level administrative and demographic data from the Michigan Department of Education, the National Center for Education Statistics (NCES), and the U.S. Census Bureau's American Community Survey (ACS). The final dataset includes 513 public school districts in Michigan and integrates information on academic performance, economic indicators, and district characteristics for the 2022–2023 (pre-policy) and 2023–2024 (post-policy) school years.

The analysis focused on three key academic benchmarks: (1) fifth-grade M-STEP percentage of students advanced or proficient in English Language Arts (ELA) and Math; (2) eighth-grade PSAT percentage of students advanced or proficient in ELA and Math; and (3) eleventh-grade SAT college readiness rates. These assessments capture student achievement across elementary, middle, and high school levels, enabling evaluation of food policy impacts across grade bands.

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The research began with exploratory visualizations of food insecurity and academic achievement across the state for the 2022-2023 school year. These included bivariate scatterplots of FRPL eligibility rates versus percentage of students advanced or proficient in state-wide standard testing (M-STEP, PSAT, SAT), as well as GIS-based choropleth maps depicting the geographic distribution of poverty, educational attainment, and academic outcomes. These visual tools provided a foundational understanding of spatial patterns and correlations within the data.

To quantify baseline correlations between food insecurity and academic performance, the ordinary least squares (OLS) regressions were used where the dependent variable was the district-level test pass rate, and the independent variables included FRPL eligibility rate, median household income, percent of adults with a bachelor's degree or higher, and locale indicators (e.g., rural, town, suburb, city).

For policy impact evaluation, boxplots and paired t-tests were first used to evaluate changes in test performance from 2022–2023 to 2023–2024 for both economically disadvantaged and economically advantaged student groups. A difference-in-differences (DID) approach was then adopted comparing changes in test performance across the two student groups. A long-form dataset was constructed with separate rows for disadvantaged and advantaged subgroups within each district and year, allowing evaluating the following model:

$$Pass\_Rate_{i,t} = \beta_0 + \beta_1 Post_t + \beta_2 Disadv_i + \beta_3 (Post_t \times Disadv_i) + \epsilon_{i,t} \quad (1)$$

In the equation, $Pass\_Rate_{i,t}$ represents the percentage of students in subgroup i and year t who meet state academic standards on M-STEP, PSAT, or SAT assessments. $Post_t$ is an indicator that equals 1 in the post-policy year (2023–24) and 0 in the pre-policy year (2022–23), capturing any statewide changes that occurred after universal free meals were introduced. $Disadv_i$ is an indicator equal to 1 for the economically disadvantaged subgroup and 0 for the non-disadvantaged subgroup, representing the baseline achievement gap between these groups. The interaction term $Post_t \times Disadv_i$ is the key parameter of interest: it measures whether the change from pre- to post-policy is larger for disadvantaged students than for their advantaged peers, and therefore serves as the causal DID estimate of the policy's differential impact.

Control variables such as FRPL eligibility rates, adult educational attainment, district expenditures, and locale were included to account for underlying socioeconomic, fiscal, and geographic differences across districts that also influence academic outcomes. Together, these components allowed the model to isolate whether disadvantaged students experienced additional academic improvements after the universal meal program went into effect.

In short, the model compared how student outcomes changed before and after the new school-meal policy and whether those changes differed between disadvantaged and non-disadvantaged districts. It tested whether universal free meals produced relatively larger gains for students facing economic disadvantage.

To improve statistical reliability, the analysis excluded any district–year–group observations in which fewer than 20 students were tested. This threshold was used because very small subgroup counts could produce unstable pass-rate percentages, large year-to-year swings driven by only a handful of students, and artificially inflated variance that could bias regression estimates. Districts with extremely small tested populations also faced strict state privacy-suppression rules, meaning that values below 20 often reflected suppressed or highly imprecise data. Applying the ≥20-student criterion ensured that each included data point reflected a sufficiently large sample to generate a meaningful proficiency percentage. In practice, this restriction removed a modest portion of the analytic dataset, reducing the sample from the full 513 Michigan districts to 281 districts for 5th-grade M-STEP, 276 districts for 8th-grade and 205 districts for the 11th-grade SAT.

4. Results

The results are presented in two parts, corresponding to the descriptive and causal components of the study. The section begin with descriptive findings from visualizations and correlation analyses, followed by regression-based estimates of policy effects.

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4.1 Descriptive Visualizations and Correlations

Figure 1 are Bivariate scatterplots that displays district-level scatterplots comparing FRPL eligibility rates (x-axis) with the percentage of students meeting proficiency benchmarks (y-axis) across the M-STEP, PSAT, and SAT assessments. Each point represents one Michigan district, and the consistent downward trend across subjects visually illustrates the descriptive relationship between higher economic disadvantage and lower academic performance. This figure provides an initial descriptive foundation for the regression analyses that follow.

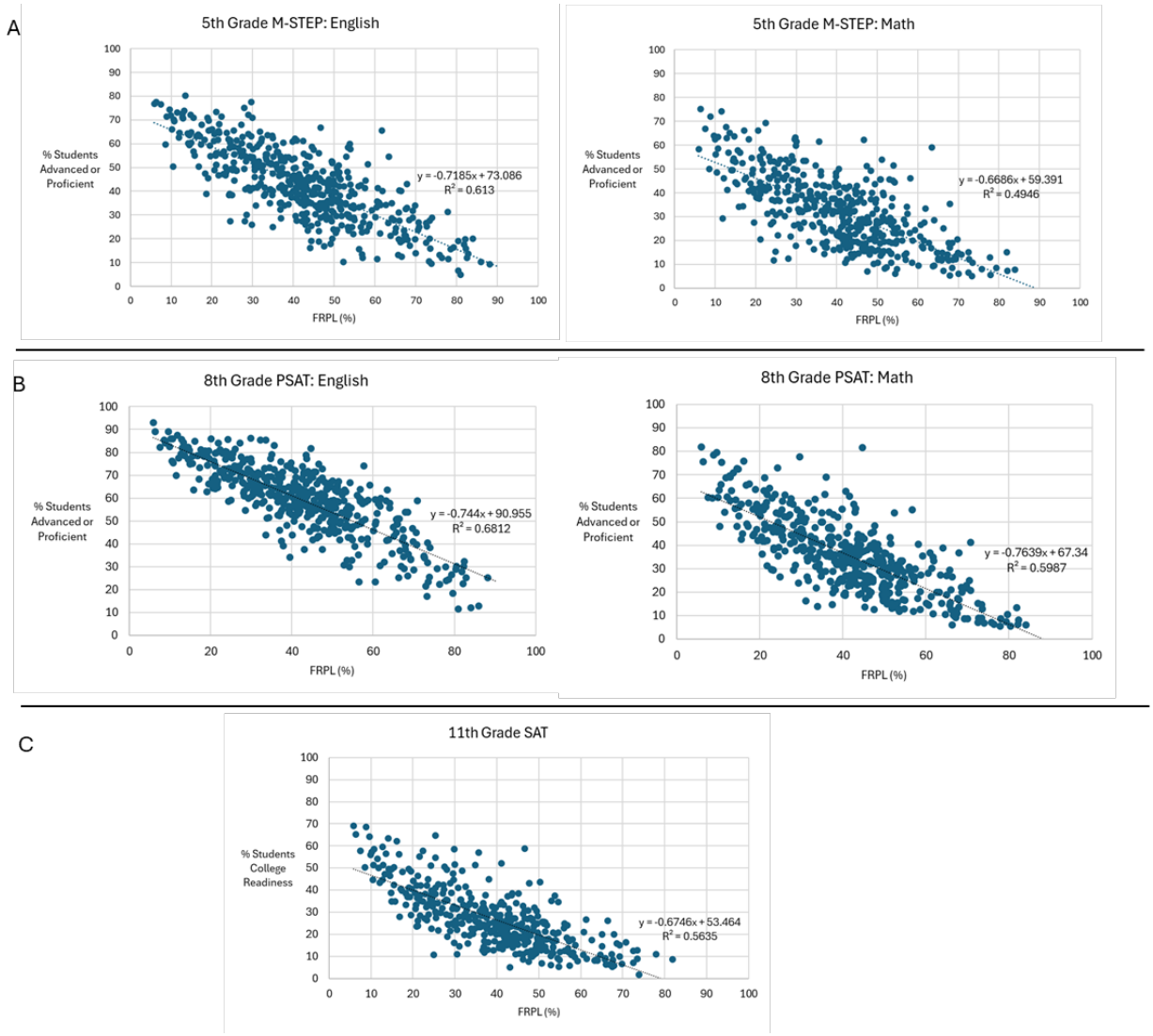

Figure 1. Students' Academic Performance Versus School District FRPL Eligibility Rate.

Figure 2 presents GIS-based choropleth maps showing the geographic distribution of district-level poverty (FRPL eligibility) and student test performance. Each polygon corresponds to a Michigan school district. The maps demonstrate visible clustering, with higher poverty and lower achievement concentrated in several urban and rural regions. These spatial patterns supplement the scatterplot evidence by revealing how socioeconomic and academic disparities are distributed across the state.

Table 1 reports the coefficients and standard errors from the ordinary least squares regressions estimating the association between FRPL eligibility, adult educational attainment, per-student expenditure, locale, and district-level proficiency rates. Separate models are presented for M-STEP ELA and Math, PSAT ELA and Math, and SAT college

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readiness. Across all grade levels and subjects, the FRPL coefficient is negative and statistically significant. The coefficient for adult educational attainment is positive. Per-student expenditure shows a small negative but statistically insignificant coefficient in most models, and locale indicators show mixed associations. These statistical patterns aligns with the visual distributions observed in Figures 1 and 2.

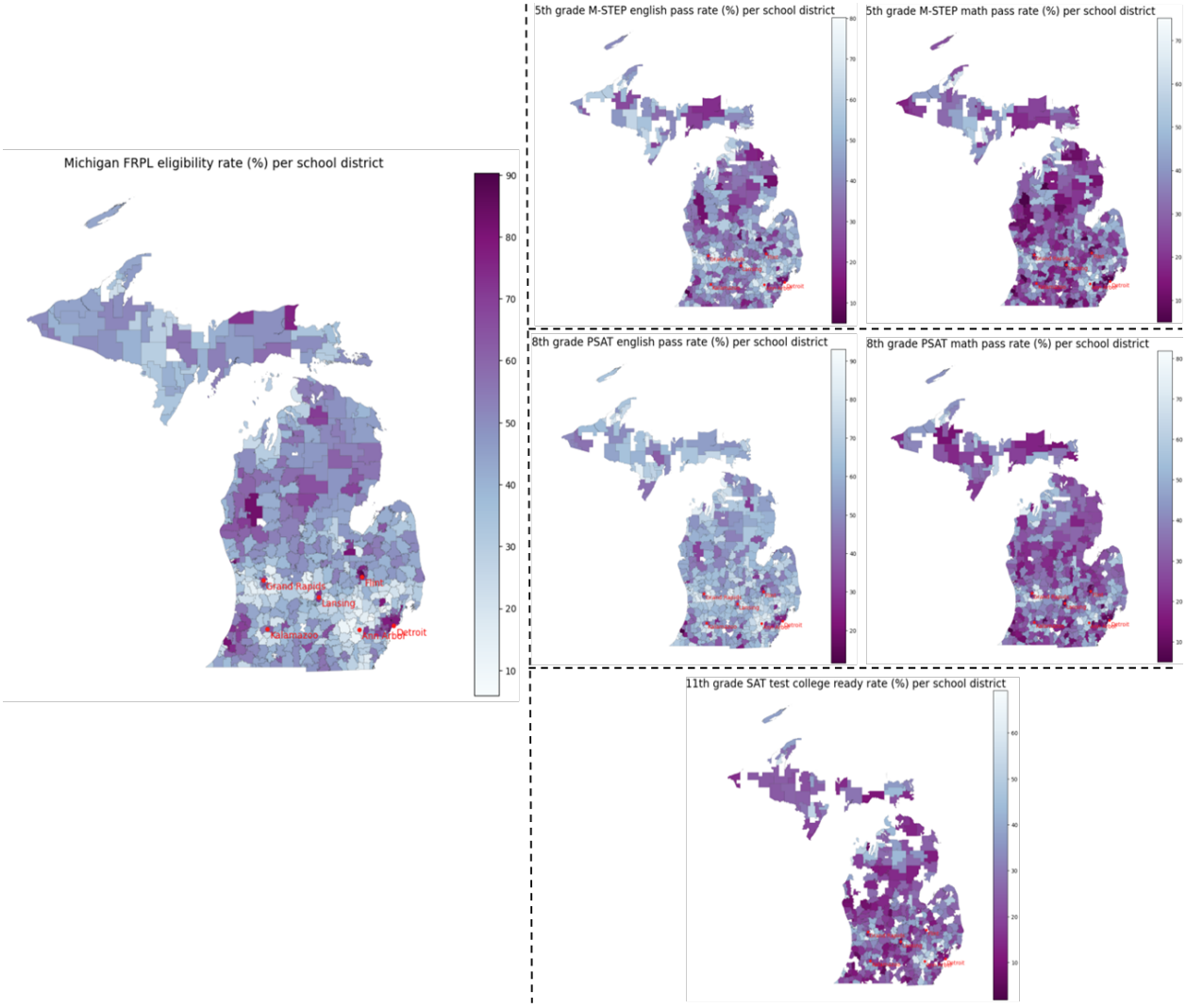

Figure 2. GIS-based Choropleth Maps.

For fifth-grade M-STEP, the estimated effect of district FRPL rate is –0.65 (SE = 0.04) in English and –0.61 (SE = 0.05) in Math. These correspond to 95% confidence intervals of [–0.73, –0.57] for English and [–0.71, –0.51] for Math, indicating that every 1-percentage-point increase in FRPL eligibility is associated with roughly a 0.6–0.7 percentage-point decline in proficiency for this grade level.

For eighth-grade PSAT, the FRPL coefficients are –0.66 (SE = 0.04) in English and –0.63 (SE = 0.04) in Math, yielding 95% confidence intervals of [–0.74, –0.58] and [–0.71, –0.55], respectively. These estimates again imply that a 1-percentage-point increase in FRPL is associated with approximately a 0.6–0.7 percentage-point decrease in the share of students meeting proficiency benchmarks.

For eleventh-grade SAT, the estimated FRPL effect is –0.58 (SE = 0.04), with a 95% confidence interval of [–0.66, –0.50], showing a similarly strong negative association at the high school level.

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Table 1. OLS regression results.

5th Grade M-STEP English Pass Rate (%)		
Variable	**Coef.**	**Std. Err.**
FRPL Rate (%)	– 0.65***	0.04
Expense per Student	0.17	0.08
% Adults with Bachelor's Degree	0.25**	0.10
Locale: Suburb (vs. City)	0.28	1.92
Locale: Town (vs. City)	– 0.73	2.12
Locale: Rural (vs. City)	– 0.19	1.99
Constant	63.9***	4.34
Notes: N = 473 districts. R^2 = 0.62.		

5th Grade M-STEP Math Pass Rate (%)		
Variable	**Coef.**	**Std. Err.**
FRPL Rate (%)	– 0.61***	0.05
Expense per Student	0.31	0.19
% Adults with Bachelor's Degree	0.29***	0.11
Locale: Suburb (vs. City)	– 0.52	2.12
Locale: Town (vs. City)	0.66	2.34
Locale: Rural (vs. City)	1.79	2.19
Constant	46.5***	4.76
Notes: N = 473 districts. R^2 = 0.55.		

8th Grade PSAT English Pass Rate (%)		
Variable	**Coef.**	**Std. Err.**
FRPL Rate (%)	– 0.66***	0.04
Expense per Student	– 0.17	0.16
% Adults with Bachelor's Degree	0.22**	0.09
Locale: Suburb (vs. City)	– 0.41	1.74
Locale: Town (vs. City)	3.32*	1.94
Locale: Rural (vs. City)	2.64	1.81
Constant	84.7***	3.90
Notes: N = 481 districts. R^2 = 0.68.		

8th Grade PSAT Math Pass Rate (%)		
Variable	**Coef.**	**Std. Err.**
FRPL Rate (%)	– 0.63***	0.04
Expense per Student	0.28	0.19
% Adults with Bachelor's Degree	0.40***	0.11
Locale: Suburb (vs. City)	0.17	2.04
Locale: Town (vs. City)	4.52*	2.27
Locale: Rural (vs. City)	4.47*	2.12
Constant	48.6***	4.57
Notes: N = 481 districts. R^2 = 0.61.		

11th Grade SAT College Ready Rate (%)		
Variable	**Coef.**	**Std. Err.**
FRPL Rate (%)	–0.58***	0.04
Expense per Student	0.39*	0.18
% Adults with Bachelor's Degree	0.43***	0.10
Locale: Suburb (vs. City)	-2.98	1.90
Locale: Town (vs. City)	0.03	2.04
Locale: Rural (vs. City)	-0.21	1.96
Constant	37.4***	4.31
Notes: N = 405 districts. R^2 = 0.60.		

❖ Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

4.2 Michigan School Meal Program Policy Impact Evaluation

Figure 3 displays boxplots comparing proficiency rates for economically disadvantaged and advantaged student groups in the 2022–23 and 2023–24 school years for the M-STEP, PSAT, and SAT assessments. Each panel shows the distribution of district-level pass rates within a subgroup and year. Across all grades, the disadvantaged group exhibits lower median proficiency, and the figure visually highlights the year-to-year changes for each subgroup.

Two observations from the boxplots can be drawn: 1) a smaller percentage of students met state academia requirements from the economically disadvantaged group compared to the advantaged group. This is consistent with what we observed previously, that the FRPL rate, which is an indicator of economic status, has a significant impact on student academic outcome. 2) While there is no consistent trend of academic improvement for both groups across the three grades from 2022-23 to 2023-24 school years, the economically disadvantaged group consistently outperforms the advantaged group in terms of either larger delta percentage improvement or smaller delta percentage decline.

Table 2 presents the difference-in-differences regression estimates for fifth-grade M-STEP, eighth-grade PSAT, and eleventh-grade SAT outcomes. The table reports coefficients for the post-policy indicator, the disadvantaged-subgroup indicator, and their interaction term, along with district-level controls. The *Disadvantaged* term is consistently negative, while the *Post* × *Disadvantaged* interaction term is small and positive across grade levels, with significance achieved in the eighth-grade models. These estimates summarize the district-level changes in proficiency before and after policy implementation for each subgroup.

Results from the DID analysis suggest that the introduction of Michigan's universal school meal program did not generate consistent, statistically significant gains in standardized test performance for the economically advantaged student group across the three grades, which is represented by the coefficients of the term *Post*. The coefficients of the term *Disadvantage* represent a statistically significant gap (~ 20%) between the economically disadvantaged group

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compared to the advantaged group across the 3 grades. Crucially, the *Post* × *Disadvantaged* interaction term represents the delta improvement of the economically disadvantaged group post the policy implementation. The coefficients of this term remain a small positive number across the three grades, implying a positive impact of the policy. However, except that the 8th grade results show moderately statistically significant, the 5th grade and 11th grade results are not statistically significant.

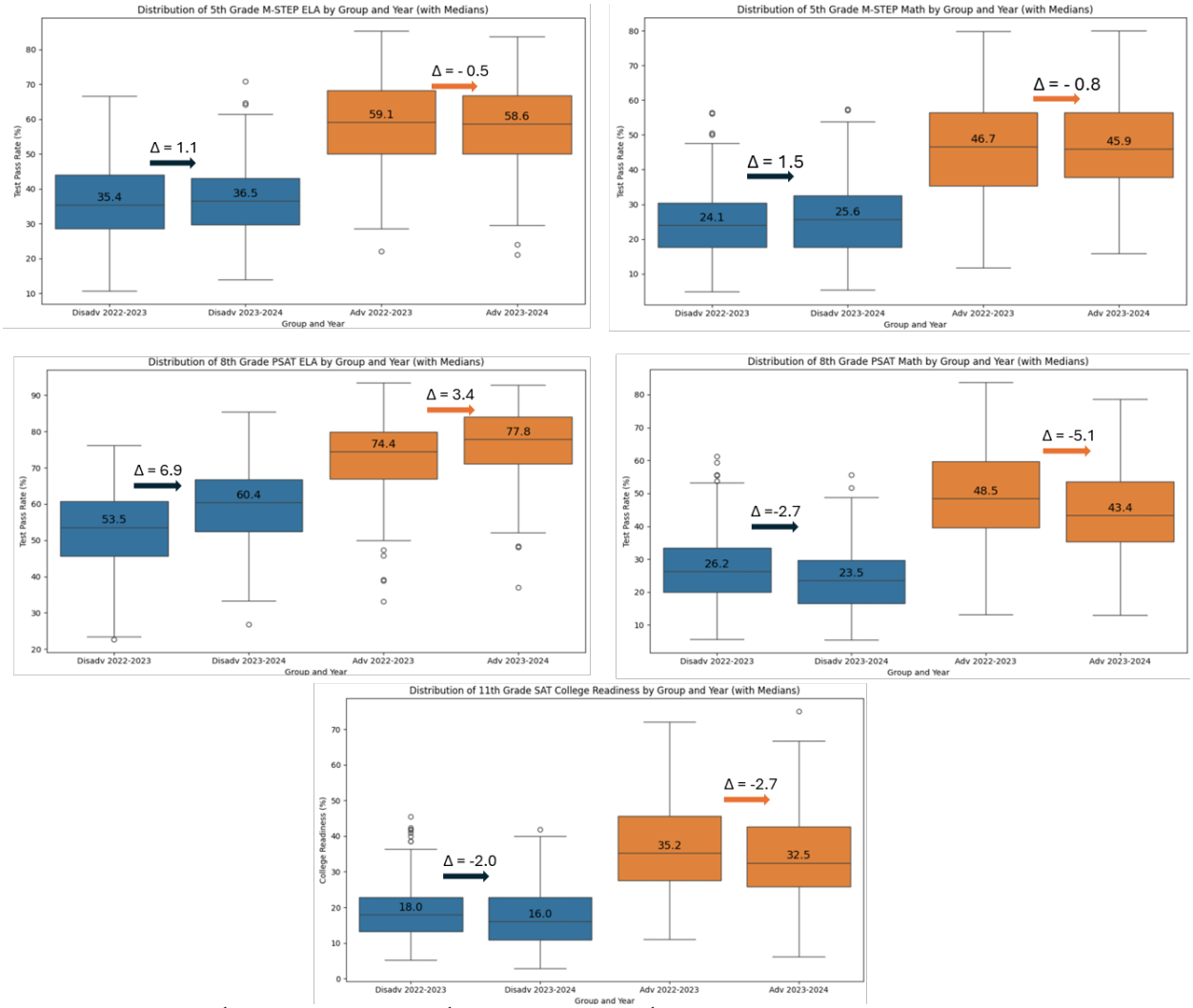

Figure 3. Boxplots on 5th grade M-STEP tests, 8th grade PSAT, and 11th grade SAT results by group and year.

Table 2. DID regression results on 5th grade M-STEP tests, 8th grade PSAT, and 11th grade SAT.

5th Grade M-STEP English Pass Rate (%)		
Variable	**Coef.**	**Std. Err.**
Post	– 0.63	0.79
Disadvantaged	– 22.2***	0.80
Post Disadvantaged	0.75	1.12
FRPL Rate (%)	– 0.34***	0.03
Expense per Student	– 0.37*	0.18
% Adults with Bachelor's Degree	0.21***	0.07
Locale: Suburb (vs. City)	– 0.34	1.15
Locale: Town (vs. City)	– 1.07	1.27
Locale: Rural (vs. City)	0.49	1.24
Constant	73.8***	3.35
Notes: N = 281 districts. R^2 = 0.65.		

5th Grade M-STEP Math Pass Rate (%)		
Variable	**Coef.**	**Std. Err.**
Post	1.18	0.85
Disadvantaged	– 21.4***	0.85
Post Disadvantaged	0.12	1.20
FRPL Rate (%)	– 0.40***	0.03
Expense per Student	– 0.43*	0.19
% Adults with Bachelor's Degree	0.15**	0.07
Locale: Suburb (vs. City)	– 2.93*	1.22
Locale: Town (vs. City)	– 1.53	1.36
Locale: Rural (vs. City)	1.11	1.33
Constant	65.4***	3.58
Notes: N = 281 districts. R^2 = 0.62.		

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8th Grade PSAT English Pass Rate (%)		
Variable	**Coef.**	**Std. Err.**
Post	4.06***	0.65
Disadvantaged	– 19.7***	0.65
Post Disadvantaged	2.60*	0.93
FRPL Rate (%)	– 0.36***	0.03
Expense per Student	– 0.65***	0.17
% Adults with Bachelor's Degree	0.21***	0.06
Locale: Suburb (vs. City)	– 0.15	0.94
Locale: Town (vs. City)	– 1.99*	1.03
Locale: Rural (vs. City)	0.66	1.04
Constant	90.9***	2.92
Notes: N = 276 districts. R^2 = 0.70.		

8th Grade PSAT Math Pass Rate (%)		
Variable	**Coef.**	**Std. Err.**
Post	– 4.75***	0.80
Disadvantaged	– 22.2***	0.80
Post Disadvantaged	1.90*	1.20
FRPL Rate (%)	– 0.44***	0.03
Expense per Student	– 0.23	0.21
% Adults with Bachelor's Degree	0.33***	0.07
Locale: Suburb (vs. City)	– 1.59	1.15
Locale: Town (vs. City)	– 2.63*	1.26
Locale: Rural (vs. City)	2.31*	1.28
Constant	62.1***	3.59
Notes: N = 276 districts. R^2 = 0.68.		

11th Grade SAT College Ready Rate (%)		
Variable	**Coef.**	**Std. Err.**
Post	– 2.22*	0.80
Disadvantaged	– 18.1***	0.80
Post Disadvantaged	0.41	1.14
FRPL Rate (%)	– 0.38***	0.03
Expense per Student	– 0.46*	0.20
% Adults with Bachelor's Degree	0.36***	0.07
Locale: Suburb (vs. City)	– 4.22**	1.05
Locale: Town (vs. City)	– 0.32	1.21
Locale: Rural (vs. City)	– 0.99	1.24
Constant	52.3***	3.57
Notes: N = 205 districts. R^2 = 0.68.		

❖ Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.10

Robustness checks that include additional control variables, such as the FRPL eligibility rate, adults' education level, and locale, confirm the finding. Interestingly, the regression also reveals a small but statistically significant negative relationship between per-student expenditure and test performance. While counterintuitive, this may reflect the fact that higher-spending districts often serve higher-need populations, such as students in poverty, English learners, or students with disabilities. These districts may receive additional funding specifically because of those needs, and their baseline academic outcomes may be more challenging to shift. In other cases, high per-student costs may be driven by structural factors like small district size or rural geography, which increase costs without necessarily improving instructional quality. Thus, the negative coefficient for spending should be interpreted cautiously as a marker of underlying need rather than inefficiency.

5. Discussion

This study explored structural relationships between food insecurity indicators and academic outcomes, as well as changes in proficiency following the implementation of Michigan's universal school-meal program. Several key insights emerged from the combined descriptive and regression analyses.

First, the descriptive scatterplots, maps, and OLS regression results consistently indicated a strong negative association between district-level FRPL eligibility and academic achievement across grade levels. Districts with higher proportions of economically disadvantaged students typically exhibited lower proficiency on the M-STEP, PSAT, and SAT assessments. These negative associations persisted even after accounting for adult educational attainment, locale, and district expenditures, highlighting the depth and consistency of socioeconomic disparities in student performance.

Second, visual comparisons of subgroup proficiency in Figure 3 suggested small, favorable shifts for economically disadvantaged students following the introduction of universal free meals. While both subgroups experienced year-to-year fluctuations, the disadvantaged group showed comparatively larger positive changes or smaller declines across the three grade levels. These descriptive patterns aligned with the positive *Post* × *Disadvantaged* coefficient observed in the DID models.

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However, the regression estimates indicated that the short-term causal impact of the Michigan School Meals Program was limited. Although the interaction term in Table 2 was positive across all assessments, it achieved statistical significance primarily in the eighth-grade results. This pattern suggested that the policy may have produced slight improvements for disadvantaged students in certain grades, but these effects were modest, inconsistent, and detectable only in some of the estimated models.

Family educational level, measured as the percentage of adults with a bachelor's degree or higher, was positively associated with student outcomes, reflecting the well-documented influence of household educational attainment on children's academic readiness, access to learning resources, and overall school engagement. Districts with more highly educated adult populations typically exhibit stronger academic performance because adult education correlates with higher income, greater availability of academic support at home, and broader community investment in education.

The negative coefficients on per-student expenditure in both the OLS and DID models also warranted careful interpretation. These negative associations likely reflected structural differences among districts rather than direct negative effects of spending. Districts with higher per-student expenditures often served smaller populations, rural communities, or higher-need student groups, where fixed costs and supplemental services raised per-pupil spending without necessarily improving immediate academic outcomes.

Overall, the findings indicated that while universal school meals may contribute to small improvements among disadvantaged students, especially in middle school, the first year of implementation did not yield substantial or broad-based gains in academic proficiency. The results aligned with expectations that nutrition policies can help reduce specific barriers related to hunger, stigma, or participation, but that meaningful shifts in achievement may require multiple years of implementation or complementary policies addressing deeper socioeconomic inequities.

Continued evaluation of Michigan's universal school-meal program will be essential as additional years of data become available. Future research should assess multi-year trends, explore variation across district types, and examine outcomes beyond test scores—including attendance, chronic absenteeism, behavior, and student health—to better understand the full scope of the program's effects.

6. Conclusion

This study evaluated the short-term academic effects of the 2023–2024 Michigan School Meals Program using district-level data across elementary, middle, and high school assessments. Three main conclusions emerge. First, strong and persistent socioeconomic gradients remain central predictors of academic performance in Michigan: districts with higher poverty and lower adult educational attainment consistently show lower proficiency rates regardless of grade level. Second, descriptive analyses reveal small but consistent improvements for economically disadvantaged students following the introduction of universal free meals, suggesting that the program may help narrow achievement gaps at the margins. Third, the causal difference-in-differences estimates provide limited evidence of statistically significant short-term academic gains attributable to the policy, with meaningful effects detected primarily among eighth-grade students.

These findings carry important implications for policymakers. Universal meal programs may reduce stigma, improve participation, and offer meaningful support to disadvantaged students, but expecting immediate, large-scale test-score improvements may be unrealistic. Academic performance is shaped by intertwined socioeconomic and structural factors, and nutrition interventions alone cannot fully offset longstanding inequities. Still, the small positive effects observed, combined with evidence from other states, suggest that universal meals may play a valuable role as part of a broader strategy to promote equity, attendance, and student well-being.

Future research should examine multi-year impacts as the program stabilizes, explore heterogeneity across district types, and consider complementary outcomes such as attendance, behavior, chronic absenteeism, or student health. Longitudinal analyses will also be essential to determine whether the modest early gains for disadvantaged students translate into sustained improvements over time. As Michigan continues to implement and refine its universal meal policy, ongoing evaluation and careful attention to equity impacts will remain crucial.

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