

Test file: Longitudinal Impact of School Nutrition Policies on Childhood Obesity Trends: A Quasi-Experimental Study

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Abstract

This quasi-experimental study evaluates the longitudinal impact of comprehensive school nutrition policy implementation on childhood obesity trends across 125 school districts. Using difference-in-differences analysis with 45,320 student observations over 5 years, we found that districts implementing strong nutrition standards demonstrated significant reductions in obesity prevalence compared to control districts. Policy effects emerged within 2 years of implementation and strengthened over time, with the most substantial impacts observed among elementary school students and children from low-income families. The findings provide robust evidence for school nutrition policies as effective strategies for obesity prevention.

Keywords: School Nutrition Policies; Childhood Obesity; Quasi-Experimental Study; Difference-in-Differences; Policy Evaluation; Obesity Prevention

1. Introduction

School environments represent critical settings for childhood obesity prevention interventions, given children's substantial time spent in educational institutions and the influential role of school food environments on dietary behaviors. In response to rising childhood obesity rates, numerous school districts have implemented comprehensive nutrition policies regulating food and beverage availability in schools. However, the longitudinal effectiveness of these policies remains inadequately characterized, with existing evidence limited by methodological constraints including short follow-up periods, inadequate control for secular trends, and insufficient attention to differential impacts across population subgroups. This study employs quasi-experimental methods to evaluate the longitudinal impact of school nutrition policy implementation on childhood obesity trends, addressing key evidence gaps through rigorous causal inference approaches and detailed examination of effect heterogeneity across demographic and socioeconomic groups.

2. Methods

2.1 Study Design and Participants

We conducted a natural experiment study leveraging variation in school nutrition policy implementation timing across 125 school districts from 2018 to 2023. The study included 45,320 students in grades K-12, with annual anthropometric measurements collected through school-based health assessments. Treatment districts implemented comprehensive nutrition policies exceeding state minimum standards, including strict nutrition standards for competitive

foods, sugar-sweetened beverage restrictions, and nutrition education requirements. Control districts maintained baseline nutrition standards without substantial changes during the study period.

2.2 Policy Exposure and Outcome Measures

Policy implementation was documented through systematic review of school district policies, with exposure classification verified through administrator surveys and policy document analysis. The primary outcome was age- and sex-specific body mass index percentile, with obesity defined as BMI ≥ 95 th percentile using CDC growth charts. Secondary outcomes included overweight prevalence, BMI z-scores, and abdominal obesity measures.

2.3 Statistical Analysis

Difference-in-differences models compared obesity trend changes between treatment and control districts before and after policy implementation. Models included district and year fixed effects, with robust standard errors clustered at the district level. Sensitivity analyses tested parallel trends assumptions, alternative model specifications, and potential confounding by concurrent obesity prevention initiatives. Subgroup analyses examined differential effects by school level, socioeconomic status, race/ethnicity, and baseline obesity prevalence.

3. Results

3.1 Policy Implementation Characteristics

Among 65 treatment districts, policy implementation spanned 2019-2021, with substantial variation in policy strength and comprehensiveness. Strong policies typically included complete elimination of sugar-sweetened beverages, stringent nutrition standards for all foods sold to students, and comprehensive nutrition education components. Policy enforcement mechanisms varied across districts, with regular compliance monitoring associated with more consistent implementation.

3.2 Primary Intervention Effects

School nutrition policy implementation was associated with significant reductions in childhood obesity prevalence. In the second year post-implementation, treatment districts demonstrated a 2.3 percentage point reduction in obesity prevalence compared to control districts. Effects strengthened over time, reaching a 4.1 percentage point reduction by year 3. BMI z-scores showed parallel reductions, with no evidence of compensatory increases in non-school energy intake.

3.3 Heterogeneity and Equity Impacts

Policy effects demonstrated significant heterogeneity across student subgroups. Elementary school students showed the largest obesity prevalence reductions, while high school students demonstrated more modest effects. Children eligible for free or reduced-price meals experienced substantially larger benefits, suggesting potential for school nutrition policies to reduce obesity disparities. Racial/ethnic minority students also showed stronger responses to policy interventions.

4. Discussion

4.1 Interpretation of Longitudinal Patterns

The progressive strengthening of policy effects over time suggests that school nutrition policies may initiate sustainable changes in children's dietary behaviors and weight trajectories. The larger effects observed among younger children highlight the importance of early intervention for establishing healthy eating patterns. The equity-promoting impacts demonstrate the potential for

school nutrition policies to address obesity disparities rooted in socioeconomic disadvantage.

4.2 Policy and Practice Implications

The findings support implementation of comprehensive school nutrition policies as effective obesity prevention strategies. Policy makers should consider mandating strong nutrition standards while ensuring adequate support for implementation and enforcement. School administrators should prioritize nutrition environment improvements alongside educational components to maximize impact. The demonstrated equity benefits argue for targeted resource allocation to schools serving disadvantaged populations.

5. Conclusion

Comprehensive school nutrition policies represent effective interventions for reducing childhood obesity prevalence, with particularly strong benefits for vulnerable populations. The longitudinal design and quasi-experimental methods provide robust causal evidence to inform education and public health policy decisions. Future policy efforts should focus on ensuring equitable implementation while maintaining strong nutrition standards to maximize population health impact.

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