

The Association Between the Introduction of a Universal School Lunch Program and Healthcare Utilization among Children in Public Assistance Households: A Difference-in-Differences Study

Kotone Tanaka

Kobe University

Daisuke Nishioka

`dicenish@peridot.kobe-u.ac.jp`

Kobe University

Haruna Kawachi

Kyoto University

Keiko Ueno

Kanazawa University

Naoki Kondo

Kyoto University

Research Article

Keywords: Children, Difference-in-differences, Healthcare utilization, Poverty, Public assistance, School lunch

Posted Date: September 23rd, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10901585/v1>

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Additional Declarations: Competing interest reported. KT, DN, HK, and KU declare that they have no competing interests. NK collaborated with Kitanihon Computer Service Co., Ltd. (KITACOM), from which the data used in this study were obtained. NK received research funding and scholarship donations from KITACOM. KITACOM had no role in the study design, data analysis, interpretation of the results, preparation of the manuscript, or the decision to submit the manuscript for publication.

Abstract

Background

Universal school lunch programs support children's nutrition and development and may serve as a safety net for socioeconomically disadvantaged children. Their effects on healthcare utilization may be bidirectional: improved nutrition may reduce healthcare needs, whereas reduced non-financial barriers and increased contact with schools may facilitate access to healthcare and increase healthcare utilization. However, evidence based on objective medical claims data remains limited. This study examined the association between the introduction of a universal school lunch program and healthcare utilization among junior high school students from households receiving public assistance in Japan.

Methods

This observational study used a quasi-experimental difference-in-differences design. The intervention group consisted of students in City A, where a school lunch program was introduced in September 2016. The control group consisted of students in neighboring City B, where a school lunch program had already been implemented. The study included 411 junior high school students from households receiving public assistance during fiscal year 2016. Medical assistance claims data were used to assess monthly medical use days, medical expenditures, outpatient visits, and any outpatient visit. Individual and month fixed effects were included in regression models. Event-study analyses were conducted to assess the parallel trends assumption and dynamic effects.

Results

Relative to the control group, the introduction of the school lunch program was associated with higher medical expenditures and outpatient utilization. The estimate for medical use days was 0.23 days per person-month ($p = 0.052$), and medical expenditures increased by 728 medical fee points per person-month, equivalent to JPY 7,280 (approximately USD 45) ($p = 0.03$). Outpatient visits increased by 0.13 visits per person-month ($p = 0.02$), and the probability of at least one outpatient visit per month increased by 5.6 percentage points ($p = 0.04$). Event-study analyses showed no systematic pre-intervention trend and were consistent with the parallel trends assumption.

Conclusions

The introduction of a school lunch program was associated with increases in several measures of healthcare utilization among junior high school students from households receiving public assistance, suggesting that such programs may have implications for healthcare use among socioeconomically disadvantaged children.

Background

Poverty is a major social determinant of health inequalities among children and is recognized as a critical public health issue globally [1]. Children raised in socioeconomically disadvantaged households are more likely to experience adverse health outcomes, with potential long-term consequences for educational attainment, labor market participation, and broader societal well-being [2]. To address these issues, many high-income countries have implemented social security systems that provide cash transfers to low-income households. However, socioeconomic disparities in children's health and healthcare utilization persist despite financial support [3, 4]. This reflects the multidimensional nature of poverty, which extends beyond a lack of income to include constraints on individuals' capabilities to lead healthy lives and participate in society [5].

Financial barriers, such as out-of-pocket medical costs, have long been recognized as major determinants of inequalities in healthcare utilization. Non-financial barriers associated with poverty, including time constraints, competing household demands, limited social support, and difficulties accessing healthcare services, may also contribute to inequalities in healthcare utilization [6, 7]. Among socioeconomically disadvantaged families, these barriers may contribute to unmet healthcare needs even when direct medical costs are reduced or eliminated. Therefore, understanding health inequalities among children requires attention not only to income support policies but also to interventions that reduce everyday burdens on disadvantaged households.

School lunch programs have attracted increasing international attention as a non-monetary policy intervention to protect child health. In Japan, they are provided in almost all public elementary schools and approximately 90% of public junior high schools [8] to improve nutritional status and promote healthy development among schoolchildren. Meals are planned by registered dietitians to meet national nutritional standards, and school lunch fees are fully covered by public funds for children from households receiving public assistance. Previous studies have shown that school lunch programs contribute to reducing socioeconomic disparities in nutritional intake [9] and obesity [10].

School lunch programs may be linked to healthcare utilization through two opposing pathways. Improved nutritional status may reduce healthcare needs by improving health outcomes (health capital model [11]). On the other hand, school lunch programs may reduce non-financial barriers to care by stabilizing school attendance and increasing opportunities for teachers and other school staff to identify children's health needs and connect families with healthcare services, thereby facilitating healthcare utilization, as suggested by the behavioral model of health services use [12]. However, the association between school lunch programs and healthcare utilization remains insufficiently understood.

Hence, this study examined the association between the introduction of a universal school lunch program and healthcare utilization among junior high school students from households receiving public assistance in Japan, using difference in the timing of municipal school lunch program implementation in a difference-in-differences framework. Japanese municipalities have historically determined whether and when to introduce school lunch programs at the junior high school level, and variation in

implementation timing provided a quasi-experimental setting for the analysis [8]. By focusing on junior high school students from households receiving public assistance, for whom out-of-pocket medical costs are waived, we sought to reduce the influence of financial barriers and more clearly examine the association between the introduction of a school lunch program and healthcare utilization.

Methods

Study design and participants

This observational study used a quasi-experimental difference-in-differences (DID) design. The intervention group consisted of junior high school students (aged approximately 12–15 years) living in City A, which introduced a school lunch program in September 2016. The control group consisted of students living in neighboring City B, where a school lunch program had already been implemented. The two municipalities are geographically adjacent and had comparable population sizes at the time of the study, while differing in the timing of junior high school lunch implementation, providing a basis for quasi-experimental comparison. Characteristics of the study municipalities are presented in **Supplementary Table 1 (see Additional file 1)**.

The study population included junior high school students from households receiving public assistance during fiscal year 2016 (April 2016–March 2017). Junior high school students were selected because early adolescence is a critical developmental period characterized by rapid physical growth, during which nutritional status has important implications for future health [13]. The study period covered 12 months, including the pre-intervention period (April–August 2016) and the post-intervention period (September 2016–March 2017). All included participants were followed throughout the entire study period. One participant from each city was excluded because their annual medical expenditures were extreme outliers and substantially influenced the group means. The final analytic sample comprised 227 students in the intervention group and 184 students in the control group (N = 411). For descriptive purposes, monthly healthcare utilization trends in neighboring City C were also presented. City C was not included in the analytic sample or the difference-in-differences analysis.

Data source

We used medical assistance claims data obtained from the welfare offices of Cities A and B. The claims data included information on the month of service, number of medical use days, medical expenditures, and type of care (inpatient or outpatient). The dataset also contained demographic and administrative information, including sex, relationship to the household head, institutionalization or hospitalization status, and disability or disease status. The data were structured as a monthly panel dataset, with one observation per participant per month throughout the study period.

Outcomes

The primary outcomes were the total number of medical use days per month and total monthly medical expenditures, including both inpatient and outpatient care. Medical expenditures were measured in Japanese medical fee points (1 point = JPY 10; approximately USD 1 = JPY 161). To assess outpatient healthcare utilization, we additionally examined the number of outpatient visits per month and the occurrence of any outpatient visit during a given month (yes/no).

Covariates

Covariates included sex (boys or girls), relationship to the household head (child or other (e.g., grandchild)), the participant's residential status (living at home, hospitalized, or residing in a facility), the participant's disability or disease status (mental disability, intellectual disability, physical disability, other disease, or none), the household head's residential status (living at home, hospitalized, or residing in a facility), and the household head's disability or disease status (mental disability, physical disability, mental illness, other disease, or none). All covariates were measured at baseline.

Statistical analysis

To examine the parallel trends assumption and changes over time associated with the introduction of the school lunch program, we conducted an event-study analysis. Indicator variables for each month relative to the introduction of the school lunch program ($t = 0$) were interacted with the treatment group indicator. The parallel trends assumption was assessed by determining whether the coefficients for the pre-intervention periods were close to zero. Post-intervention coefficients were used to assess the timing and persistence of the DID estimates.

The main analysis employed a DID approach using a two-way fixed-effects regression model with individual and month fixed effects. The DID estimates were given by the coefficient of the interaction term between the post-intervention indicator and the treatment group indicator. Regression coefficients are presented with 95% confidence intervals calculated using cluster-robust standard errors at the individual level to account for within-individual correlation across repeated monthly observations.

The model was specified as follows:

$$[Y_{it} = \alpha + \beta (Post_t \times Treat_i) + \gamma_i + \delta_t + \epsilon_{it}]$$

where (Y_{it}) denotes the monthly outcome for individual (i) at time (t), ($Post_t$) indicates the post-intervention period, and ($Treat_i$) indicates membership in the intervention group. γ_i and δ_t represent individual and month fixed effects, respectively, and ϵ_{it} denotes the error term. The coefficient (β) represents the estimated difference in pre-to-post changes in healthcare utilization between the intervention and control groups.

Two sensitivity analyses were conducted. First, we excluded August 2016, when school lunches were not provided during the summer vacation. Second, to examine potential confounding by the health status of

the household head, we conducted a sensitivity analysis allowing temporal trends in healthcare utilization to vary according to the presence or absence of disability or disease in the household head. This analysis was restricted to participants with complete information on the health status of the household head. All analyses were conducted using R version 4.4.1. Statistical significance was defined as a two-sided p-value < 0.05.

Results

Descriptive statistics

Table 1 presents the baseline characteristics of the study participants. The study included 411 junior high school students, comprising 227 participants in the intervention group and 184 participants in the control group. Baseline characteristics were generally similar between the two groups, although the prevalence of disability or disease among household heads was slightly higher in the control group than in the intervention group.

Table 1
Baseline characteristics of study participants

n	Intervention group	Control group
	(City A) n = 227	(City B) n = 184
	227	184
Boys, n (%)	101 (44.5)	89 (48.4)
Relationship to household head, n (%)		
Child	217 (95.6)	179 (97.3)
Other [e.g., grandchild]	10 (4.4)	5 (2.7)
Participant's residential status, n (%)		
Living at home	227 (100.0)	184 (100.0)
Hospitalized	0 (0.0)	0 (0.0)
Residing in a facility	0 (0.0)	0 (0.0)
Participant's disability or disease status, n (%)		
Mental disability	2 (0.9)	0 (0.0)
Intellectual disability	4 (1.8)	8 (4.3)
Physical disability	1 (0.4)	0 (0.0)
Other disease	1 (0.4)	4 (2.2)
None	219 (96.5)	172 (93.5)
Household head's residential status, n (%)		
Living at home	220 (98.2)	178 (99.4)
Hospitalized	3 (1.3)	1 (0.6)
Residing in a facility	1 (0.4)	0 (0.0)
Household head's disability or disease status, n (%)		
Mental disability	4 (1.8)	4 (2.2)
Physical disability	1 (0.4)	1 (0.6)
Mental illness	14 (6.2)	26 (14.5)
Other disease	11 (4.9)	23 (12.8)
None	194 (86.6)	125 (69.8)

Raw trends

Figures 1 and 2 show the mean number of medical use days and medical expenditures (medical fee points) per person-month in the intervention and control groups. The vertical dashed line indicates September 2016, when the school lunch program was introduced.

During the pre-intervention period, healthcare utilization followed generally parallel trends in the two groups. Following the introduction of the school lunch program, the number of medical use days decreased in the control group but increased in the intervention group. Similarly, medical expenditures decreased in the control group, whereas they remained relatively stable in the intervention group.

As an additional validity check, trends in healthcare utilization in neighboring City C are presented in **Supplementary Figs. 1 and 2**. Trends in both medical use days and medical expenditures in City C were generally consistent with those in the control group, providing descriptive evidence of similar trends elsewhere in the region.

Event-study analysis

Figures 3 and 4 present the event-study estimates for medical use days and medical expenditures per person-month, respectively, before and after the introduction of the school lunch program.

The event-study analysis showed no systematic upward or downward pattern in the pre-intervention estimates, and the 95% confidence intervals for all pre-intervention coefficients included zero. These results did not indicate a clear deviation from the parallel trends assumption. Following the introduction of the school lunch program, the estimated coefficients became positive immediately after implementation (month 0) and remained generally positive for the subsequent 6 months.

Difference-in-differences analysis

Table 2 presents the results of the difference-in-differences analysis for the number of medical use days and medical expenditures per person-month. The DID estimate for medical use days was 0.23 medical use days per person-month ($p = 0.052$). The DID estimate for monthly medical expenditures was 728 medical fee points per person-month, equivalent to approximately JPY 7,280 (approximately USD 45) ($p = 0.03$).

Table 2
Difference-in-differences estimates for medical use days and medical expenditures

Medical use days per person-month	Difference-in-differences	p value
	Estimate (95% CI)	
	0.23 (-0.002, 0.47)	0.052
Medical expenditures per person-month (medical fee points)	727.58 (56.91, 1398.26)	0.03
Note: Estimates were obtained using difference-in-differences models with individual and month fixed effects. Values are presented as regression coefficients with 95% confidence intervals (CI). Medical expenditures are expressed in Japanese medical fee points per person-month (1 point = JPY 10; approximately USD 0.06, based on USD 1 = JPY 161).		

The DID estimate for the number of outpatient visits was 0.13 visits per person-month ($p = 0.02$). The corresponding estimate for the probability of having at least one outpatient visit per month was 5.6 percentage points ($p = 0.04$) (**Supplementary Table 2**).

Sensitivity analyses excluding August 2016, when school lunches were not provided because of summer vacation, yielded estimates similar in direction and magnitude to those of the main analysis. The DID estimates were 0.22 medical use days per person-month ($p = 0.10$) and 542 medical fee points per person-month ($p = 0.055$).

In an additional sensitivity analysis allowing temporal trends to vary according to the health status of the household head, the DID estimate on medical use days was 0.26 days per person-month ($p = 0.04$), and the DID estimate on medical expenditures was 769 medical fee points per person-month ($p = 0.04$). These estimates were similar in direction and magnitude to those of the main analysis.

Discussion

Among junior high school students from households receiving public assistance, the introduction of a school lunch program was associated with higher medical expenditures and outpatient healthcare utilization. The DID estimate for medical use days was also positive, although the p -value was 0.052. These findings suggest that the potential association of school lunch programs may extend beyond nutrition to healthcare utilization among socially disadvantaged children. Importantly, because all participants had their medical fees covered by the public assistance system and therefore faced no out-of-pocket medical costs, the observed increase in healthcare utilization is unlikely to be explained by changes in financial affordability. Instead, among socioeconomically disadvantaged adolescents, increased utilization may reflect improved access to necessary healthcare and a reduction in previously unmet healthcare needs despite the absence of financial barriers to healthcare. These findings suggest that non-financial barriers may play an important role in shaping healthcare utilization among socioeconomically disadvantaged children [14, 15].

The observed increases in the probability of any outpatient visit and visit frequency may reflect different aspects of healthcare utilization [16]. The increase in the probability of any outpatient visit suggests a greater likelihood of seeking care, whereas the increase in visit frequency suggests greater overall use of outpatient healthcare. Although the absolute increase in outpatient visits (0.13 visits per person-month) was modest at the individual level, it was accompanied by an increase in the probability of having at least one outpatient visit. Together, these findings are consistent with the possibility that the school lunch program facilitated access to healthcare among children with previously unmet healthcare needs.

One possible explanation is that the school lunch program may have reduced non-financial barriers to healthcare utilization. Because medical care is provided without out-of-pocket costs under the public assistance system, these barriers may be related more to time constraints and competing household demands than to financial costs. By reducing the burden of preparing daily lunches, the school lunch program may have freed household resources and facilitated healthcare-seeking behavior.

School lunch programs may also facilitate healthcare utilization by increasing children's contact with schools. Shared school meals provide opportunities for interaction between students and teachers, potentially enhancing teachers' awareness of students' health-related needs [17]. In addition, previous systematic reviews have suggested that school meal programs may improve school attendance, although the overall evidence remains mixed. Notably, improvements in attendance have been reported among higher-risk populations, including children from lower-income or food-insecure households [18, 19]. By promoting school attendance, school lunch programs may therefore increase opportunities for teachers and school staff to recognize children's health-related needs and facilitate access to appropriate healthcare.

These findings suggest that school lunch programs may be considered not only as nutritional interventions but also as components of broader social protection strategies for children in public assistance households. They may complement conventional income-support policies by addressing barriers to healthcare utilization that cannot be resolved through financial support alone. Unlike cash transfers, school lunch programs are embedded within children's daily environments and may influence healthcare access through mechanisms beyond income supplementation. Although the mechanisms underlying the observed increase in healthcare utilization remain unclear, our findings suggest that the benefits of school lunch programs may extend beyond nutritional improvement. School lunch programs may therefore function as an in-kind social protection policy that may be associated with healthcare access through non-financial pathways.

This study has several limitations. First, although the difference-in-differences design with individual and month fixed effects controlled for time-invariant unobserved confounding, we could not completely rule out time-varying confounders. Municipality-specific changes, such as the introduction of other policies or programs occurring concurrently with the school lunch program, may have influenced the results. Second, healthcare utilization may reflect both changes in health status and healthcare-seeking behavior. Although the claims data allowed us to measure healthcare utilization, we lacked detailed

information on health conditions and potential mechanisms linking school lunch provision to healthcare use, such as school attendance and interactions with teachers and school staff. Therefore, we were unable to determine whether the observed increase in healthcare utilization resulted from changes in underlying health conditions, improved access to healthcare, or increased opportunities for health needs to be identified through school attendance. Future studies integrating healthcare claims with data on health conditions, school attendance, and other educational and social factors are needed to clarify these mechanisms. Third, the study population was limited to junior high school students from households receiving public assistance in two neighboring municipalities, who faced virtually no out-of-pocket medical costs. Therefore, caution is warranted when generalizing the findings to other socioeconomically disadvantaged populations or populations with financial barriers to healthcare.

Conclusions

In conclusion, the introduction of a school lunch program was associated with higher medical expenditures and outpatient healthcare utilization among junior high school students from households receiving public assistance. These findings suggest that school lunch programs may function not only as nutritional interventions but also as components of social protection policies with potential implications for healthcare access through non-financial pathways among socioeconomically disadvantaged children.

Abbreviations

CI	
Confidence interval	
DID	
Difference-in-differences	
JPY	
Japanese yen	
JSPS	
Japan Society for the Promotion of Science	
KITACOM	
Kitanihon Computer Service Co., Ltd	
USD	
United States dollar	

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the relevant guidelines and regulations of the Japanese government and the Declaration of Helsinki. The study protocol was approved by the Ethics Committee

of Kyoto University Graduate School and Faculty of Medicine (approval no. R3356), which waived the requirement for informed consent. The municipalities provided anonymized data to the researchers, and no personally identifiable information was available to the research team.

Consent for publication

Not applicable.

Availability of data and materials

The data used in this study were obtained from participating municipalities in Japan. However, there are restrictions regarding the availability of these data, which were used under license for the current study and are not publicly available. The data are available from the authors upon reasonable request, with permission from the participating municipalities.

Competing interests

KT, DN, HK, KU declare no competing interests associated with this manuscript. NK collaborated with Kitanihon Computer Service Co., Ltd. (KITACOM) from which the data used in this study were obtained. NK received research funds and scholarship donations from KITACOM. The research funding bodies had no discretion or involvement in the study protocol, analysis, interpretation of the results, or submission of this manuscript.

Funding

This study was supported by the Yazuya Shoku to Kenko Research Institute and the Japan Society for the Promotion of Science (JSPS) KAKENHI (grant numbers 26K13092 and 26K02612). The funding bodies had no role in the design of the study; the collection, analysis, or interpretation of the data; the writing of the manuscript; or the decision to submit the manuscript for publication.

Authors' contributions

KT conceptualized and designed the study, analysed the data, and prepared the manuscript. DN contributed to the study design, interpretation of the findings, and critical revision of the manuscript. HK,

KU, and NK reviewed the manuscript. KT finalized the manuscript. All authors read and approved the final manuscript.

Acknowledgments

We also thank the municipal welfare officers and Kitanihon Computer Service Co., Ltd. (KITACOM) for providing the data used in the present study.

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Figures

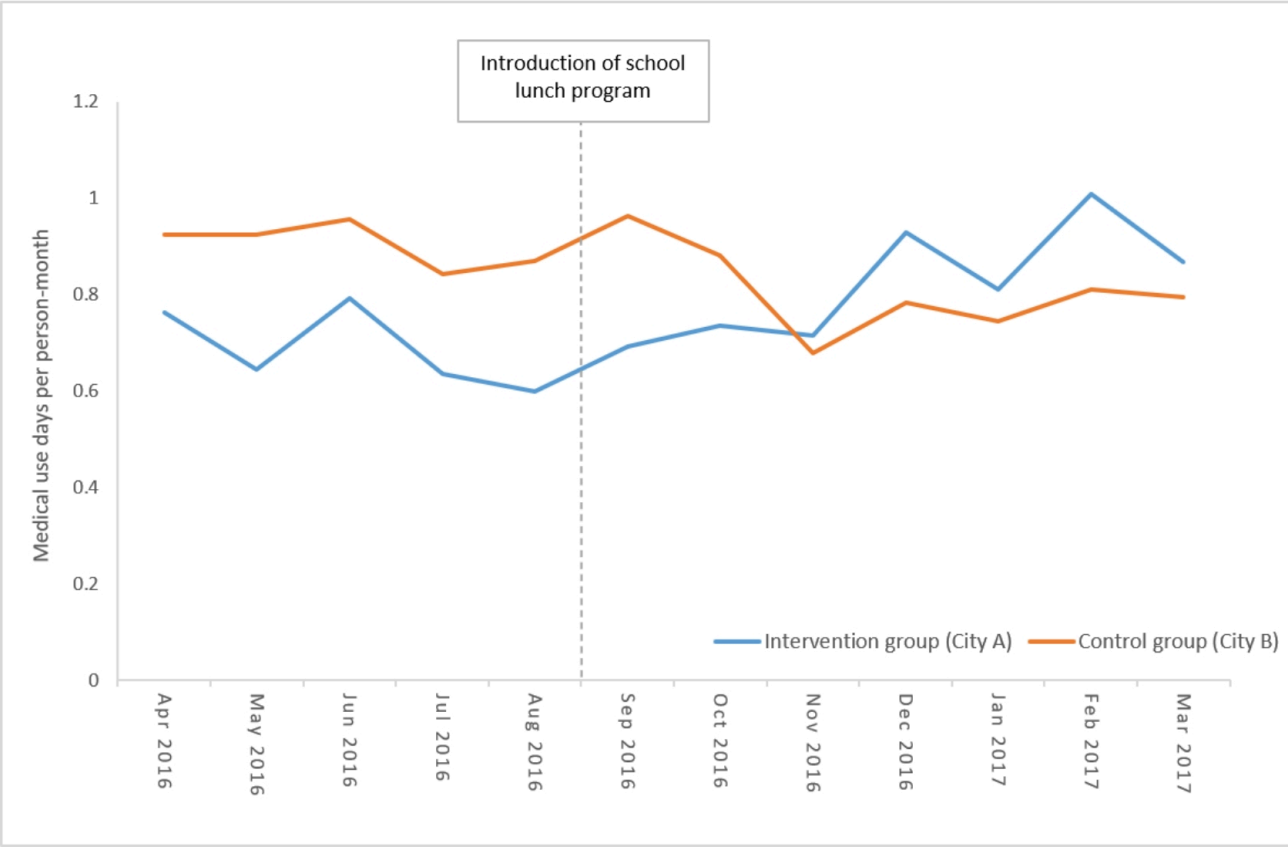


Figure 1

Monthly medical use days before and after school lunch introduction.

Monthly medical use days per person-month in the intervention and control groups. The vertical dashed line indicates the introduction of the school lunch program in September 2016.

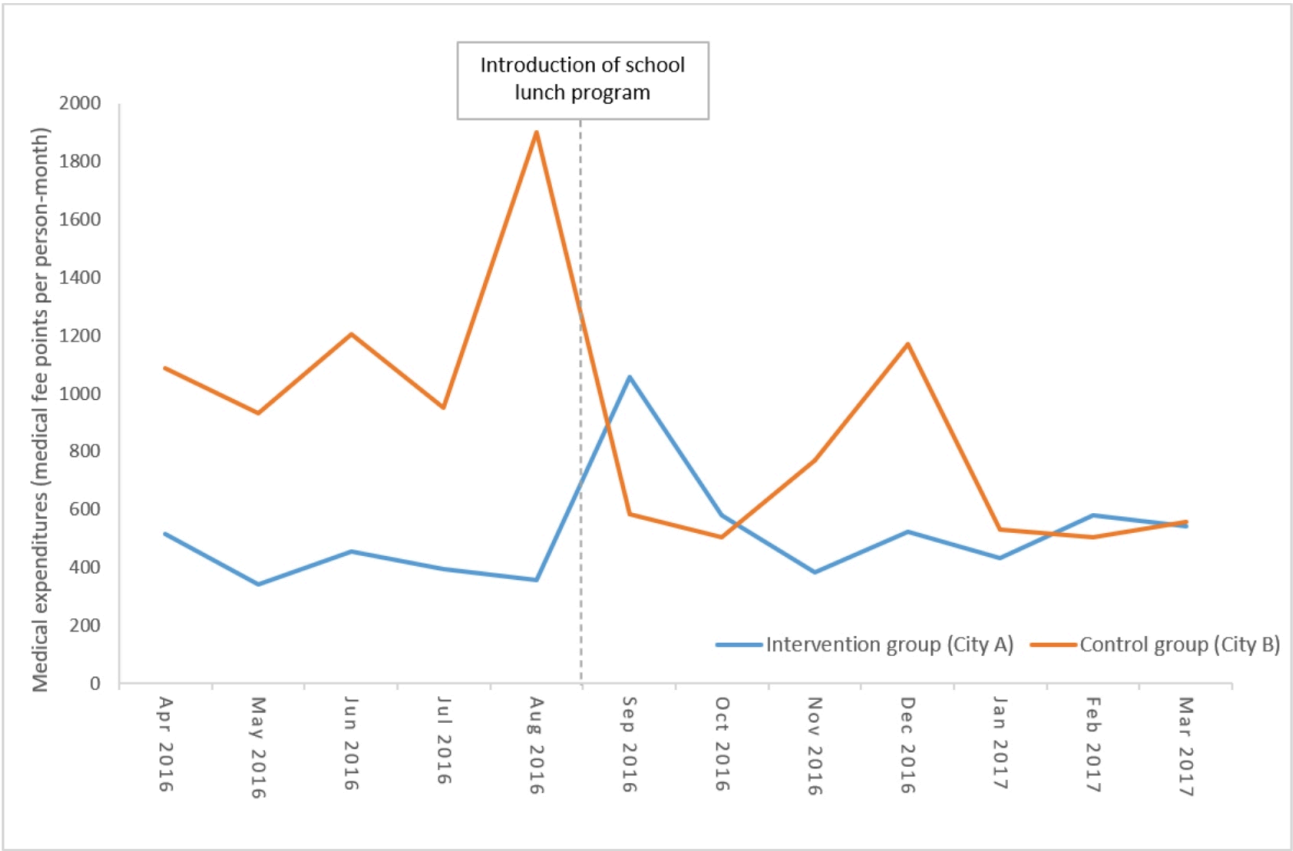


Figure 2

Monthly medical expenditures before and after school lunch introduction.

Monthly medical expenditures (medical fee points) per person-month in the intervention and control groups. The vertical dashed line indicates the introduction of the school lunch program in September 2016.

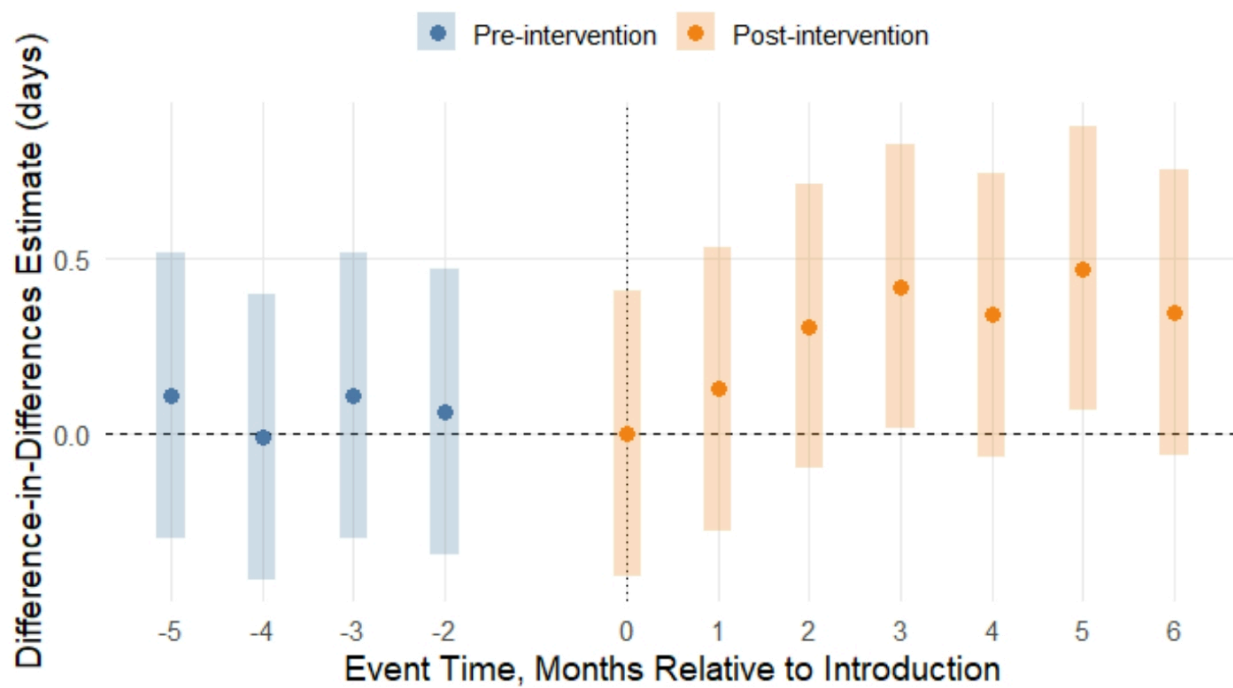


Figure 3

Event-study estimates for monthly medical use days.

Points represent the estimated difference-in-differences coefficients relative to the month immediately before the introduction of the school lunch program (reference period = month -1), and vertical bars indicate 95% confidence intervals.

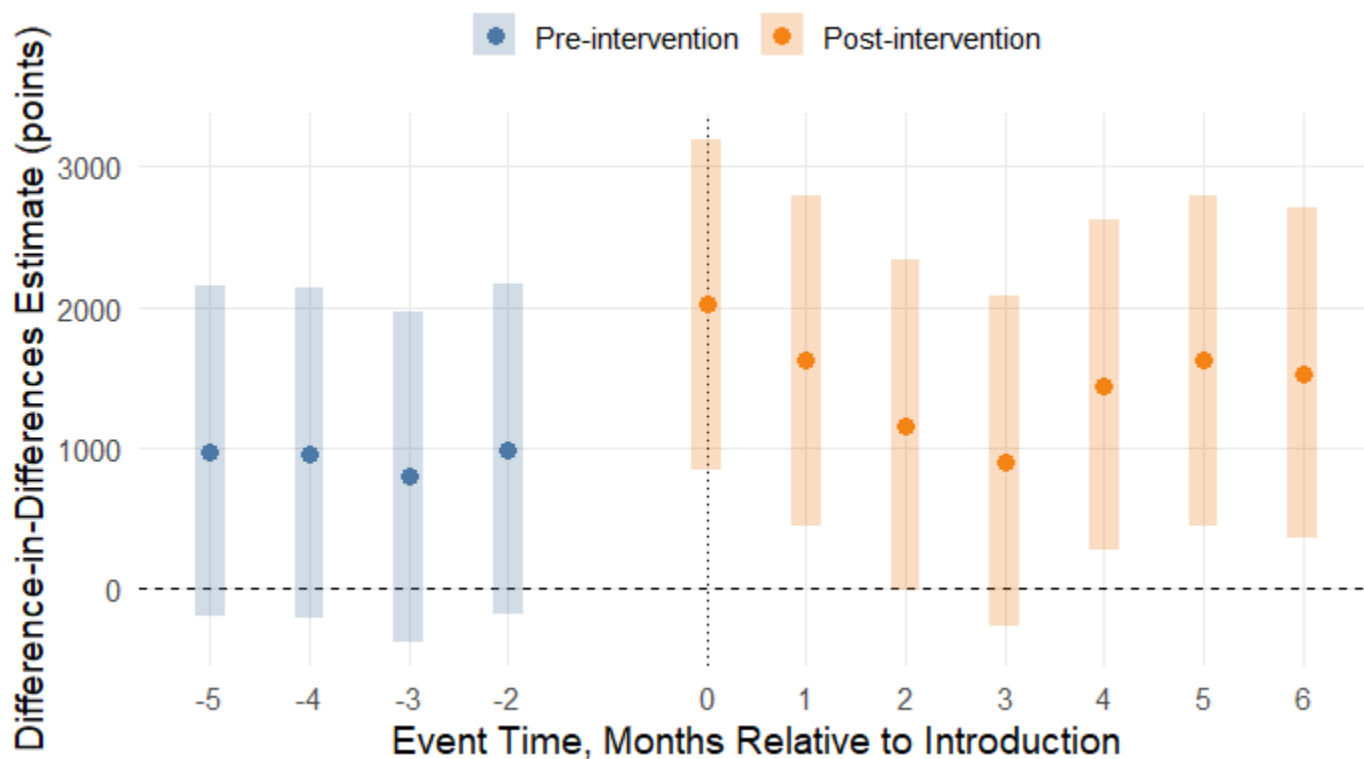


Figure 4

Event-study estimates for monthly medical expenditures.

Points represent the estimated difference-in-differences coefficients relative to the month immediately before the introduction of the school lunch program (reference period = month -1), and vertical bars indicate 95% confidence intervals.

Supplementary Files

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