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The Effect of Silent Eating during Lunchtime at Schools on the COVID-19 Outbreaks*

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Abstract

Silent eating—no talking during mealtimes—was used as a measure to reduce the spread of infectious diseases during the COVID-19 pandemic because the emission of droplets during conversations was considered a risk factor for spreading the virus. Japan implemented silent eating during school lunchtimes in February 2020, and it remained in effect until November 2022. However, concerns have been raised regarding the potentially negative effects of the policy on children's well-being and educational attainment. More importantly, no study to date has examined its effectiveness in reducing the risk of COVID-19 outbreaks. This study aims to address this important knowledge gap by examining the impact of silent eating on the risk of COVID-19 outbreaks. In November 2022, the Japanese government announced that silent eating in public schools was no longer needed, triggering some schools to discontinue this measure while other schools continued its implementation. Utilizing this cancelation of the silent eating requirement as a natural experiment, we investigated whether silent eating was associated with a reduced risk of COVID-19 outbreaks. We measured the probability of class closures in public schools (the government's guidelines required class closures when more than one child in a class was infected with COVID-19) by applying a Difference-in-Differences model with two-way fixed effects to panel data. We found no evidence that silent eating was associated with a reduced probability of class closures. Heterogeneity analysis also revealed that our findings did not vary by school characteristics. Our findings indicate that policymakers should be cautious about using silent eating at schools as a potential lever to control outbreaks of infectious diseases.

Keywords: silent eating; class closure; COVID-19 pandemic; Japan
JEL classification: I18; I28

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1 Introduction

The COVID-19 virus has become one of the deadliest communicable disease of the 21st century, causing almost seven million deaths globally (World Health Organization, 2023). Mortality from this disease has been reduced significantly by the development of effective vaccines and treatments, as well as the emergence of the Omicron variant. Until effective vaccines became available in late 2020, non-pharmacological interventions (NPIs)—such as social distancing, wearing face masks, restricting travel, closing schools, tracing contacts, and quarantines—have been the main public health interventions used to mitigate the spread of this virus (Brothers, 2020).

The Japanese government introduced a school closure policy to control the COVID-19 pandemic on February 27, 2020 (Miyawaki & Tsugawa, 2022). When the school closure policy was lifted in May 2020, the Japanese government introduced a policy that requested children to avoid talking while eating lunch at school, also known as silent eating (*mokushoku* in Japanese) (McCurry, 2022). The Novel Coronavirus Expert Panel, a committee of epidemiologists and medical doctors who advised the Japanese government regarding COVID-19-related policies, released the "New Normal Practice" on May 4, 2020, which suggested that children "concentrate on eating and talk less" (Prime Minister's Office of Japan, 2020). This policy was established based on studies showing that the COVID-19 virus spreads mainly through person-to-person contact via respiratory droplets produced by infected people when they cough, sneeze, or talk. Research on a cluster of cases in restaurants also indicated that the COVID-19 virus can be transmitted from more than six meters away (Kwon et al., 2020). Another research project constructed mobility networks from mobile-phone geolocation data and suggested that reopening full-service restaurants after a lockdown contributed to far greater numbers of infections compared to reopening fitness centers, hotels, and motels (Chang et al., 2021).

In response to the recognized risk of infection through conversations during meals, silent eating became widely adopted as a preventive measure. For instance, central and local governments, such as in the Tokyo, Saitama, Chiba, and Kanagawa Prefectures, emphasized the importance of silent eating at a press conference on January 29, 2021 (Tokyo Metropolitan Government, 2021). On February 4, 2022, following the spread of the Omicron variant, a government meeting of the Subcommittee on Novel Coronavirus Disease Control recommended silent eating for both adults and children (Cabinet Secretariat, 2022c). The government officially stated the importance of silent eating in its revised version of the "Basic Policy for Novel Coronavirus Control," released on February 10, 2022 (Cabinet Secretariat, 2022a). Silent eating remained a COVID-19 countermeasure until the final revision of the "Basic Policy for Novel Coronavirus Control" on November 25, 2022 (Cabinet Secretariat, 2022b). Schools have followed the silent eating guideline set by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and local governments' boards of education to deal with COVID-19 infections at schools. MEXT released its guideline on May 22, 2020, which included a recommendation for silent eating during lunchtime (Ministry of Education, Culture, Sports, Science and Technology, 2022b). In Japan, school lunch is often provided by local governments at the parents' expense, and this is also the case in all public schools in our study area (i.e., Chiba Prefecture). Students eat lunch from the same menu while seated in their classrooms with their classmates and homeroom teachers. Thus, after the release of MEXT's guideline, students ate lunch in their classrooms with their peers and a homeroom teacher but were not allowed to have conversations during lunchtime. This policy remained in effect even while the number of infected patients declined.

The recommendation for silent eating persisted for approximately 2.5 years until November 29, 2022, when it was removed from the revised guideline (Ministry of Education, Culture, Sports, Science and Technology, 2022a; Yomiuri Shimbun, 2023). On April 1, 2023, MEXT stated that silent eating was no longer a requirement in schools as long as children could maintain social distancing (Ministry of Education, 2023). However, even after the Japanese government's decision to lift the silent eating policy in November 2022, some schools voluntarily continued to enforce restrictions on children talking during lunch.

Despite the nationwide implementation of silent eating for over two years, evidence is lacking as to whether silent eating at schools is effective in reducing the risk of COVID-19 outbreaks. The only available scientific evidence stems from simulations produced by the supercomputer, *Fugaku*. According to the simulations, the probability of infection from 15 minutes of face-to-face conversation at a distance of at least one meter is estimated to be about 60%. However, the risk is much lower if a person infected with COVID-19 wears a well-fitting cloth mask (Onishi et al., 2022). Regarding the risk associated with conversation during eating and drinking, previous literature suggested that the number of droplets reaching a person sitting next to the speaker is approximately five times greater compared to when sitting across a table (Tsubokura, 2022). Conversely, the number of droplets is reduced to almost a quarter when individuals are seated diagonally across from each other. These findings suggest that silent eating could potentially generate fewer droplets and aerosols that cause COVID-19 transmission, thereby potentially exerting a preventive effect on the spread of infection. However, to our knowledge, no study to date has investigated whether silent eating at schools is associated with reduced probability of COVID-19 outbreaks.

This study takes advantage of these school-level variations in silent eating as a natural experiment to estimate the impact of silent eating on temporary class closures resulting from an increase in the number of students with COVID-19 infections. To examine the causal impact, we use Difference-in-Differences (DiD) models with two-way fixed effects (TWFE). Chiba Prefecture, one of the largest prefectures in Japan, provided administrative data about schools' reactions to silent eating after the revision of the guideline as well as daily basis records of class closures at each school.

The regression results from the classroom-level analysis suggest that silent eating leads to a slight decrease in the probability of class closures by -0.2 percentage points (95% confidence interval: -0.5 percentage points, 0.1 percentage points). Similarly, at the school level, there was a modest decline in the number of class closures, estimated at -0.023 classes, and a decrease of -0.2 percentage points in the rate of class closures. However, neither of these effects was statistically significant. The results are robust across specifications. In conclusion, there is no clear evidence that silent eating decreases the risk of class closures.

This study contributes to the existing literature on infection prevention measures. It is worth noting that the introduction of silent eating in schools is not unique to Japan. For instance, in the early stages of the COVID-19 pandemic, the silent eating measure was adopted at the discretion of schools in Korea (Yoon et al., 2020), Canada (CTV News, 2021), and the United States (Peetluk et al., 2021). However, as in Japan, there has been no investigation conducted to assess its effectiveness in school facilities in those countries.

In contrast, a few studies on silent eating in non-school settings were explored. For example, a study conducted in South Korea examined 98 healthcare workers who regularly ate at a hospital cafeteria in South Korea between January 2020 and September 2021 (Jung et al., 2022). The findings revealed that individuals who refrained from talking while eating were less likely to experience the COVID-19 infection compared to those who engaged in conversation (silent eating group: 0% [0/74] vs. non-silent eating group: 12.5% [3/24], P=0.013). However, healthcare workers arguably have the highest risk of contracting COVID-19 infections compared with those in other occupations, and it remains unknown whether similar findings could be found among other populations. Given that Japan was the only country implementing silent eating nationwide in schools under the government's guideline, it presents an ideal opportunity to explore and examine the effectiveness of the silent eating measure specifically in school setting.

Furthermore, investigating the impact of silent eating has an important policy implication. The silent eating program has been a subject of policy debate due to the lack of evidence regarding its effectiveness in reducing the spread of the virus and its potential impact on children's educational achievement and development. A study conducted in Japan found significantly higher satisfaction with lunchtime among students in schools without the silent eating measure compared to schools that continued to enforce it (Takaku & Wang, 2022). The study found an increase of 13.5 percentage points in the proportion of children who enjoy lunchtime. Considering that control of probable future pandemics from other infectious diseases will continue to rely on NPIs, it is critically important to understand the effectiveness of silent eating at schools on the spread of virus.

The paper proceeds as follows. Section 2 explains when and how silent eating began during lunchtime at schools in Japan. Section 3 describes the method and data used in this study. Section 4 presents the results, and Section 5 concludes and discusses the implications of the results.

2 Method

2.1 Sample and data collection

One of Japan's 47 prefectures, Chiba, provided the data used in this study. Chiba Prefecture is located in the Kanto metropolitan area adjacent to Tokyo and is the sixth largest prefecture in the country. The number of infected patients in Chiba Prefecture and nationwide is highly correlated (corr.=0.942, between September 21, 2022, through May 2, 2023). The number of infections among children and adolescents (nineteen-years-old and younger) and adults (twenty-years-old and older) is also highly correlated (corr.= 0.955 between September 21, 2022, through May 2, 2023). There are 763 elementary and 388 junior high schools across 54 cities in the Chiba Prefecture. Although we were allowed to access the administrative data on only public schools, the proportion of private schools in Chiba Prefecture is quite small; only 1.3% of elementary and 6.2% of junior high schools are private. Thus, exploring Chiba Prefecture's public schools would produce generalized findings for the entire country.

We constructed the panel data by combining the following two data sets. The first data set is the survey conducted by Chiba Prefecture's board of education in mid-January 2023 to obtain the school-level implementation status on silent eating during lunchtime. The data include the name of the school, whether the school maintained or lifted the silent eating mandate, and the date and month when the silent eating requirement was removed. We found that 45 schools—36 elementary and nine junior high schools—lifted silent eating. We ensured that these schools are not concentrated in one or two particular cities but are scattered throughout 11 cities in Chiba Prefecture. In our baseline estimation, we restrict the data to schools located in these 11 cities. Note that some schools were scheduled to lift silent eating during January 2023 and are classified as schools that canceled the practice.

The second data set is the administrative data on daily class closures at each school. In our analysis, we used three outcome measures from this data set: the occurrence of class closures at the classroom level, the total number of closed classes at the school level, and the ratio of those closed to the total number of classes at the school level. Since most schools that lifted silent eating during lunchtime decided to discontinue the practice after January 11, 2023, we focus on 73 days around January 11: from November 1, 2022, to February 28, 2023, excluding Saturdays, Sundays, and holidays. As a result, the number of treatment schools that continued silent eating is 157, while the number of control schools in the same 11 cities that lifted silent eating is 45 during the above period. In terms of the number of classes, there were 2,090 classes in the schools that continued silent eating and 553 classes in the schools that discontinued it. Note that school closure is implemented class by class, indicating that some classes can be temporarily closed while others are not, even in the same grade.

The government guideline presented strict criteria for temporary class closures due to the spread of the COVID-19 infection. The criteria are; (i) when more than one student in the same class is found to be infected, (ii) when there are multiple students with undiagnosed colds or other symptoms in the vicinity, even if only one student is confirmed to be infected, and (iii) when the principal deems it necessary to close classes. However, on August 19, 2022, MEXT revised this guideline on the criteria for class closures, stating that “even if multiple students are confirmed to be infected in the same class, school closure may not be imposed if there is no linkage of infection routes among those students or no risk of spread of infection to other students in the class.” The decision to close classes is made by principals based on the number of students infected, and there is very little room for principals' discretion.

Several points must be clarified here. First, the data on the number of students infected at each school is a more direct measure of outcomes but it is not available to us. Therefore, we rely on class closures as an alternative outcome measure. As shown in Figure 1, there exists a strong correlation between the number of infected patients and class closures (corr.=0.78). Thus, we use class closure as a proxy for the number of students infected.

Second, it may be a natural consequence not to have detected any significant effect of silent eating on class closures if the numbers of infected patients were minimal around January 11, 2023. However, this period coincided with the 8th wave of the COVID-19 pandemic. Despite a decline in the number of COVID-19 patients in Chiba Prefecture, the number was still substantial, with 9,071 cases reported on January 11. For comparison, the daily highest number of infected patients in November 2022 was 6,036 (November 30), in December 2022 it was 9,520 (December 27), and in January 2023 it was 10,182 (January 7).

2.2 Balance test

Previous research suggested that class size has a causal effect on the incidence of class closures due to influenza infection (Oikawa et al., 2022). Given that classroom areas are fixed, smaller class sizes make it easier for students keep socially distant from their peers in a classroom. To test whether school characteristics, such as class size, are systematically different between treatment and control schools, we performed a balance test and found no statistically significant differences in any school characteristics between the two groups (see Table 1). In addition, we compare the two groups regarding their share of natural areas in the school district (as a proxy for population density), the number of hospitals in the school district, and the distance from the school to the nearest hospital (km); we found no statistical difference in those variables. Finally, the occurrence, rate, and number of class closures prior to the implementation of lifting silent eating are presented below in Table 1. No significant differences were found between the two groups for either of these indicators.

3 Results

3.1 Benchmark estimation

We employ Difference-in-Differences (DiD) models with two-way fixed effects (TWFE). Among the three dependent variables, one is at the classroom level (a dummy variable that takes the value of 1 if the class is closed), and the other two are at the school level (i.e., the class closure rate and the number of class closures). Consequently, for the classroom-level analysis, we incorporate fixed effects for both the classroom and the school days, while for the school-level analysis, fixed effects are applied for the school and school days. The estimation equation is written as follows:

$$Y_{it} = \alpha + \beta Treat_i \times \tau_t + \rho_i + \tau_t + \varepsilon_{it}, \qquad (1)$$

where Y_{it} is the outcome of interest (i.e., occurrence of class closures at the classroom level, class closure rate at the school level, or the number of class closures at the school level) for class/school i in day t. $Treat_i$ in equation (1) is a dummy variable that takes a value of one when class/school i continued silent eating during lunchtime and zero otherwise. ρ_i is the class- or school-specific fixed effect for class/school i, which reduces the unobserved time-invariant differences across classes/schools. τ_t represents a time dummy. Equation (1) is estimated using ordinary least squares (OLS), and standard errors are clustered at the class/school level to account for correlations in error term ε_{it}.

The key identifying assumption of DiD is that the average number of class closures between treatment and control schools follows the parallel trends before the event. Panel A of Figure 2 shows the class closure rate from April 1, 2021, through January 11, 2023, when most schools lifted silent eating, excluding Saturdays, Sundays, and holidays. As shown in Panel A, there is no apparent difference in the time trends before lifting silent eating for the two groups. In addition, Panel B of Figure 2 displays the occurrence of class closures at the classroom level from November to December 2022.

Assuming that the average treatment effect at the class/school level is homogeneous across treated classes/schools and over time, with the assumption of parallel trends in the absence of treatment, the coefficient β in equation (1) identifies the average treatment effect on the treated (ATT) of lifting silent eating during lunchtime. The TWFE model allows us to address several issues that could result in estimation bias. In particular, we can rule out the possibility that the outcomes are affected by class- or school-level time-invariant differences, such as location, facility, quality of school, and students' demographic factors.

However, the assumptions underlying the TWFE model are relatively strong. When treatment effects are heterogeneous across observations or time, the TWFE estimator might not consistently estimate the ATT. To address this issue, we employed the robust estimators proposed by De Chaisemartin and d'Haultfoeuille (2020), as recommended in prior research (Braghieri et al., 2022). These robust estimators allow us to relax the strict assumptions of the TWFE model and produce more reliable and generalizable treatment effect estimates.

We conducted an event study analysis using the De Chaisemartin and d'Haultfoeuille (2020) estimator to assess the validity of the parallel trends assumption and examine the dynamics of treatment effects. Figure 3 presents the event study figures for the class closures at the classroom level (Panel A), the class closure rate at the school level (Panel B), and the number of class closures at the school level (Panel C). The x-axis shows the days relative to the first day of lifting silent eating in control schools, labeled as day 0.

Our results, shown in Figure 3, indicate that the estimated coefficients of the class closures before lifting the silent eating order were statistically insignificant and close to zero for all estimators, indicating that the parallel trends assumption was satisfied. This suggests no differential trends in class closures between the treatment and control groups during the pre-treatment period. During the post-treatment period, Panel A shows a slight decrease in class closures around ten days after lifting the silent eating protocol at school; however, this coefficient was statistically insignificant. Moreover, the coefficient remained close to zero after day 10. Similar results were also found for the class closure rate and the number of class closures at the school level, as shown in Panels B and C of Figure 3.

Table 2 presents the results of the TWFE model in equation (1). Columns 1 and 2 show the estimated coefficients and standard errors for the classroom level estimation (i.e., the occurrence of class closures), while columns 3 to 6 present the corresponding results for the school level analysis (i.e., the class closure rate and the number of class closures). To test the robustness of the treatment effect, we report results for two different samples: schools within the municipality that lifted silent eating (odd-numbered columns) and only primary schools within the same city (even-numbered columns). Consistent with the event study analysis results, the estimated coefficients were statistically insignificant and close to zero for all estimations.

Based on the findings presented in Figure 3 and Table 2, we did not find strong evidence supporting the notion that silent eating during lunchtime at school would decrease the spread of infection. Even if there were a decrease, it would likely be minimal, with an average effect size of -0.2 percentage points.

3.2 Heterogeneity

We further conducted two types of analysis to investigate possible heterogeneity in the effects of silent eating using the baseline specification. First, we estimated the effects of the interaction between the dummy variable for silent eating and each subsample dummy variable. For subsample dummy variables, we utilized four variables related to school characteristics (i.e., the total number of students, the total number of teachers, the total number of classrooms, and average class size) and two variables for characteristics of school districts (i.e., the share of natural area and the number of hospitals). The results are presented in Figure 4. We observed that the estimated coefficients for the class closures at the classroom level and the class closure rate at the school level were close to zero and statistically insignificant for all subpopulations. Although the standard errors tended to be large for the number of class closures, we found that none of the interaction terms were significant.

Second, we divided primary school classes into two groups: a lower grade class encompassing grades one to three and an upper grade class comprising grades four to six. We subsequently performed an event study regression for each of these groups. It is possible that the differential impacts of silent eating may be observable between the lower and upper grades of primary school.

One potential explanation could be that students in the lower grades may continue to voluntarily engage in silent eating even after the practice is no longer mandatory. This behavior might be due to silent eating becoming a familiar practice for them, gradually integrating it into their daily routines from their initial year in primary school. If this assumption holds true, we would expect the effect of silent eating to be less pronounced in the lower grade classes, while silent eating may reduce the risk of class closures, particularly for the upper grade classes.

Conversely, it is also possible that silent eating may have an effective impact in the lower grades and may not function as effectively in the upper grades. In general, students in the lower grades are more challenging to organize compared to those in the upper grades. Therefore, after the lift of silent eating, students' conversations during lunchtime could potentially intensify, leading to an increased risk of droplet infection. Under these circumstances, the effect of silent eating is likely to be higher in the lower grade classes than the upper grade classes. Either of these hypotheses could account for the differential effects of silent eating between lower and upper grades, and thus, we estimate the impact of silent eating separately for each group.

Figure 5 shows the results of event study regression, with Panel A presenting the results for the lower grades and Panel B for the upper grades. In both sets of results, the coefficient takes a negative value 10 days after the lift of the silent eating policy, but none of the post-lift results are statistically significant, which is consistent with the benchmark results presented in Panel A of Figure 3. Based on these findings, we could not find any evidence supporting the possibilities discussed above and, therefore, conclude that the effects of silent eating do not significantly differ across grades.

3.3 Mechanism

Why does silent eating have little clinically meaningful effect on class closures? Previous research is convincing that talking at restaurants raises the risk of COVID-19 infections (Chang et al., 2021; Kwon et al., 2020). However, these studies may not apply to other settings. Lunchtime at school is only 45 minutes, including preparation time for serving food, etc., which is a much shorter dwell time than adults spend in restaurants. Furthermore, students wear masks even during the preparation time for lunches. The time dedicated to actual eating is further limited to approximately 15 minutes. Therefore, lunchtime and the time allocated for eating are relatively brief in the school environment, which suggests that the impact of silent eating may not have been significant in reducing class closures.

Schools follow strict guidelines to reduce the risk of COVID-19 transmission, such as practicing social distancing, washing hands frequently, and ventilating the classroom. On July 14, 2022, in response to the Omicron variant, the Subcommittee on Novel Coronavirus Disease Control released a recommendation to emphasize strict ventilation at specific places, including schools, with a focus on addressing the risk of aerosol and droplet transmission (Cabinet Secretariat, 2022d). This recommendation was prompted by the National Institute of Infectious Diseases, which, for the first time in March 2022, issued a warning about the risk of aerosol transmission (National Institute of Infectious Diseases, 2022). Following the recommendation, MEXT specified strict ventilation measures and provided guidelines on possible ventilation methods. These countermeasures, with particular emphasis on ventilation, are likely to be more crucial in reducing transmission risk compared to the impact of silent eating.

3.4 Limitation

There are three considerations when generalizing these results and using them in practice. First, this analysis focused on the situation immediately after lifting the silent eating guideline. During this period, students may have been more cautious about talking and continued to take preventive measures against COVID-19, even without the requirement to eat without conversing. Hence, it is unclear whether we would obtain the same result as in this study when students are less careful as time goes on.

Second, immediately after lifting silent eating, schools may have been more careful about students' infections than usual. Particularly, there is a concern that schools may have ensured infection control not only during lunchtime but also throughout the school day. Therefore, the results presented in this study may not show the pure impact of silent eating on class closures but rather the impact of silent eating *and* enhancing the COVID-19 countermeasures taken by schools.

The third point is that the analysis covered only 11 cities in Chiba Prefecture, where silent eating at school was altered after the government revised its guideline. Furthermore, the percentage of schools that lifted silent eating was 22.3% (=45/202), meaning that these schools were still limited even in these 11 cities. It remains unclear whether we would reach the same conclusion if other schools, cities, or even other prefectures decided to lift silent eating during lunchtime at school. Further explorations will be needed in this field of study.

4 Discussion

Silent eating may have a side effect on children's skill formation, despite our finding that silent eating had little clinically meaningful impact on the spread of infection. In particular, social interaction is essential for children's immediate and long-term futures. Solid evidence shows that social interaction helps them develop substantial academic achievements (Brown & Taylor, 2009) and fosters prosocial behavior, including tolerance for others and the promotion of gender equality (Dhar et al., 2022; Getik & Meier, 2021; Rao, 2019). Shobako (2022) suggested that silent eating ruined the benefits of food education and changed students' eating habits.

In addition, Takaku and Wang (2022) criticized that many schools continued silent eating for approximately 2.5 years, regardless of the state of the epidemic situation of COVID-19. While infections occurred in cyclic waves, allowing adults to temporarily return to normal life during the phases of decreasing infection numbers, such flexibility was not extended to children at school. The lack of flexibility in government guidelines may have resulted in losing an opportunity to invest in students' human capital.

These findings emphasize the need to strike a balance between infection prevention measures and the overall well-being and developmental needs of children. As indicated by the results of this study, infection prevention measures in schools are not always effective as expected. For instance, Fukumoto et al. (2021) found no significant effect of school closure from March to June in 2020 in Japan on the spread of COVID-19. Conversely, school closures in Japan were found to adversely affect the mental health of children (Kishida et al. 2021) and lead to issues in behaviors and social relationships (Hagihara et al., 2022; Nakayama et al. 2021; Ueno & Yamamoto, 2022).

It is imperative for the government to continually assess the efficacy of infection prevention measures in schools and be cognizant of their potential side effects on students. In addition, policy guidelines should account for the dynamic nature of pandemics and provide greater flexibility to adapt to changing circumstances while prioritizing the educational and social development of students.

5 Conclusion

In this study, we investigated the impact of the silent eating measure on the spread of infection in public schools in Japan. By applying a DiD model with two-way fixed effects, we find that silent eating during lunchtime had minimal effects in reducing the occurrence of class closures at the classroom level, the class closure rate at the school level, and the number of class closures at the school level. The marginal decrease observed in all estimations was not statistically significant. Moreover, the analysis of heterogeneity showed that silent eating had consistent and statistically insignificant effects across different school characteristics. These results provide evidence that lifting the requirement of silent eating does not increase the risk of class closure.

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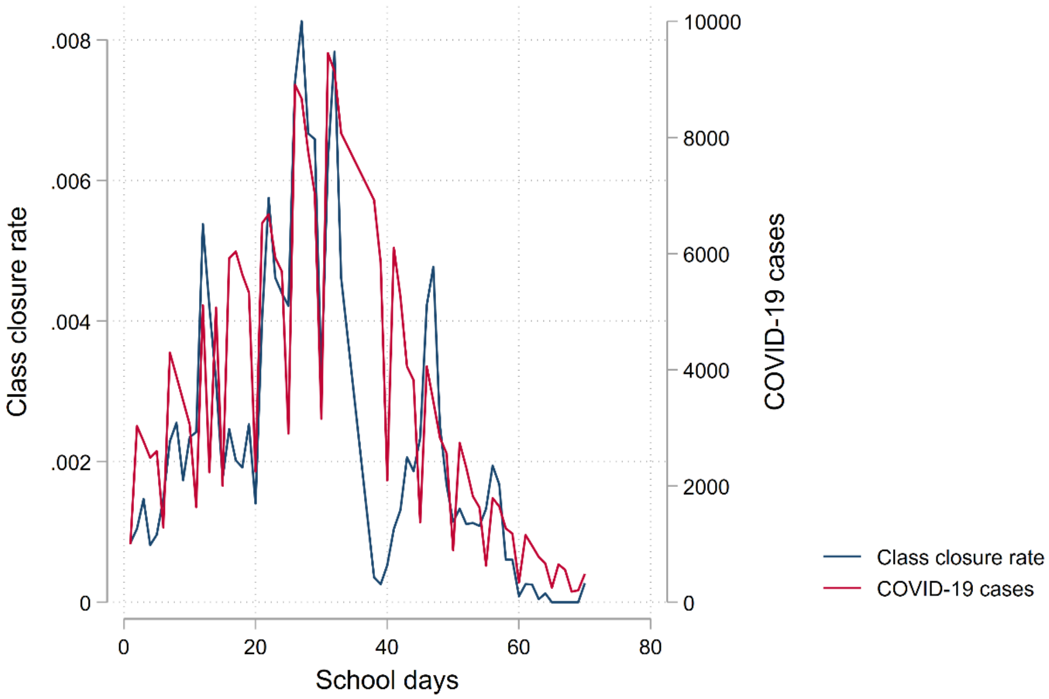


Figure 1: Average class closure rates and number of COVID-19 cases in Chiba prefecture since November 1, 2022 through February 28, 2023.

Panel A Panel B

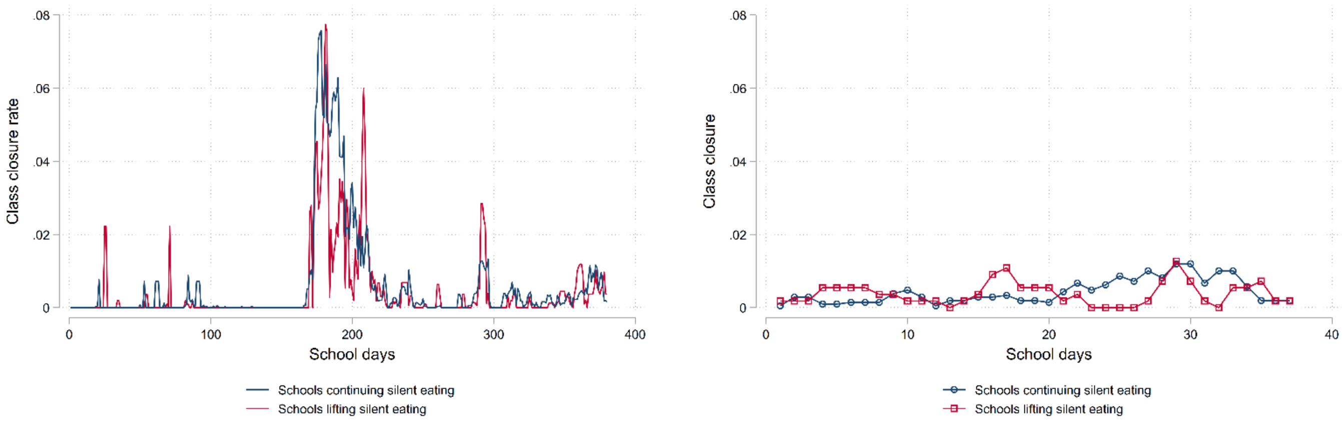


Figure 2: Class closure in schools continuing and lifting silent eating. Panel A shows the class closure rates at the school level from April 2021 to the end of December 2022. Panel B is the occurrence of class closures at the classroom level from November to December 2022.

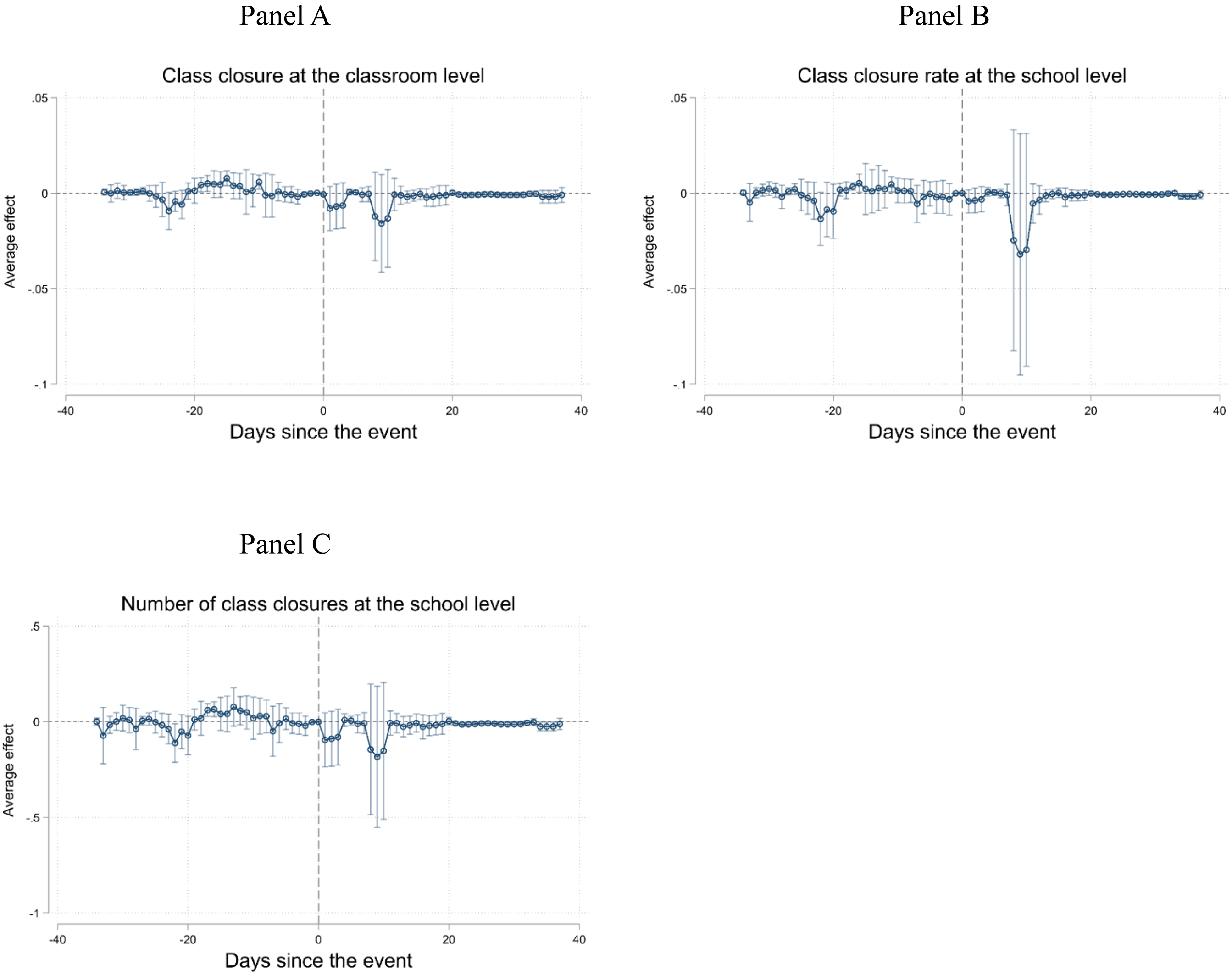


Figure 3: Event study using De Chaisemartin and d'Haultfoeuille (2020). Panel A shows the results for class closures at the classroom level. Panel B displays the results for class closure rates at the school level, while Panel C is the number of class closures at the school level. The figures plot the average treatment effects for each day, and the bars represent 95% confidence intervals. Standard errors are clustered at the class/school level.

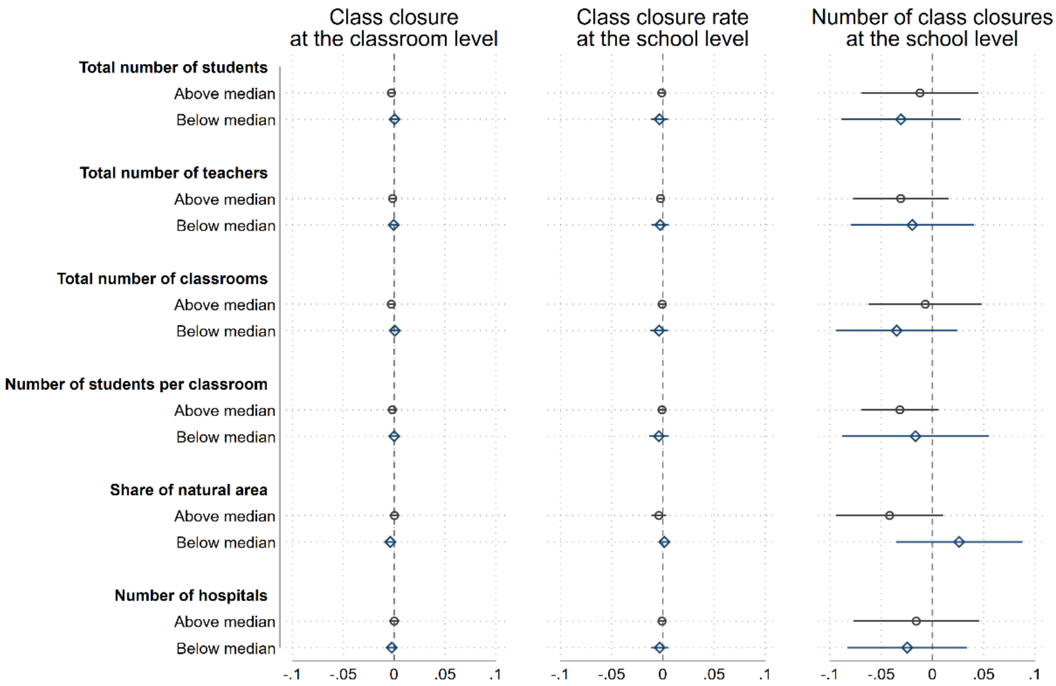
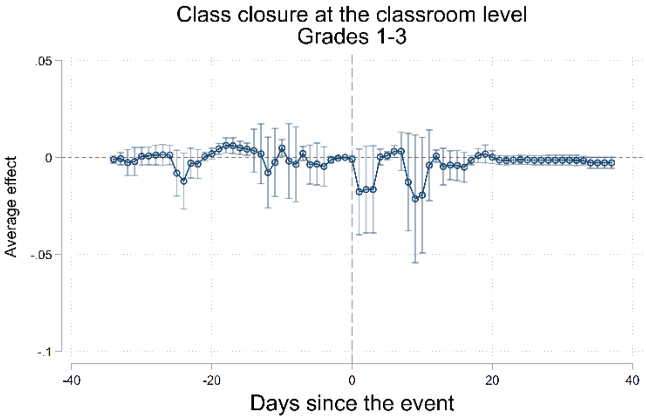


Figure 4: Heterogeneity across subsample. For the school characteristic variables shown in the header, dummy variables were created for each subsample (i.e., above and below the median) and interacted with the dummy for silent eating. Regression estimates with 95% confidence intervals based on cluster-robust standard errors are reported.

Panel A



Panel B

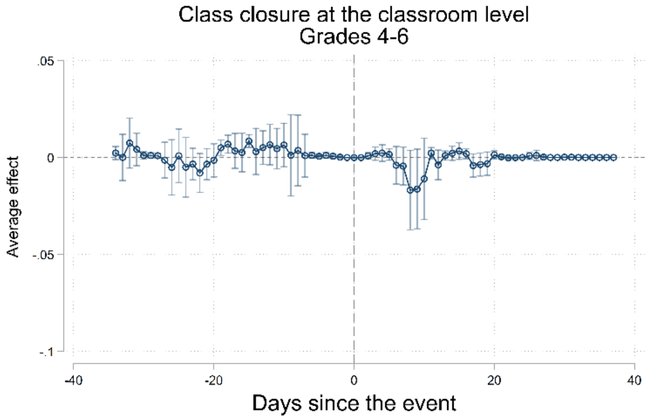


Figure 5: Heterogeneity across grades. Panel A shows the results of class closures at the classroom level for first through third grades in primary schools, while Panel B displays the results for fourth through sixth grades in primary schools. The figures plot the average treatment effects for each day, and the bars represent 95% confidence intervals. Standard errors are clustered at the class level.

Table 1: Summary statistics

	Treatment (1)	Control (2)	Total (3)
Number of schools	157	45	202
Number of classes	2,090	553	2,643
Total number of students	406.000	369.200	397.802
	(238.938)	(280.015)	(248.414)
Total number of teachers	25.561	23.733	25.153
	(9.637)	(11.957)	(10.196)
Total number of classes	13.261	12.244	13.035
	(6.598)	(8.082)	(6.947)
Class size (average number of students per class)	28.840	28.693	28.807
	(7.174)	(6.708)	(7.057)
Share of natural area in the school district	0.495	0.587	0.515
	(0.342)	(0.317)	(0.338)
Number of hospitals in the school district	13.766	11.930	13.365
	(14.518)	(15.332)	(14.680)
Distance from school to nearest hospital (km)	0.414	0.495	0.432
	(0.440)	(0.462)	(0.445)
Class closures at the classroom level for November and December 2022	0.004	0.004	0.004
	(0.066)	(0.061)	(0.065)
Class closure rate at the school level for November and December 2022	0.003	0.004	0.003
	(0.024)	(0.039)	(0.028)
Number of class closures at the school level for November and December 2022	0.039	0.044	0.040
	(0.305)	(0.317)	(0.308)

Note: The treatment group comprises the schools continuing silent eating during lunchtime, and the control group is the schools lifting silent eating. Standard deviations are in parentheses. There is no statistically significant difference in any variable between the groups.

Table 2: Effect of silent eating on class closures

Dependent variable	Class closures at the classroom level		Class closure rate at the school level		Number of class closures at the school level	
Observations	All schools	Primary only	All schools	Primary only	All schools	Primary only
	(1)	(2)	(3)	(4)	(5)	(6)
Silent eating * day	-0.002	-0.002	-0.002	-0.003	-0.024	-0.023
	(0.002)	(0.002)	(0.003)	(0.003)	(0.022)	(0.028)
Time fixed effects	YES	YES	YES	YES	YES	YES
School fixed effects	YES	YES	YES	YES	YES	YES
Number of observations	198,225	141,375	14,140	9,730	14,140	9,730
R-squared	0.037	0.039	0.056	0.059	0.065	0.068
Mean of dependent variable	0.003	0.003	0.003	0.003	0.040	0.045

Note: The silent eating variable represents whether the school continued silent eating. Standard errors clustered at the school level are in parentheses.