Quasi-experimental methods in evaluating effects of COVID-19 policies

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Seminar on quasi-experimental methods

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Topics

- Research on COVID-19 pandemic
  - Quality of research
  - Research designs

- Examples on quasi-experimental studies
  - School closures
  - Stay-at-home-orders
  - Masks

Quality of research on COVID-19

- COVID-19 pandemic and various mitigation policies or non-pharmaceutical interventions have been studied in thousands of studies in different fields
    - a lot of variation in data and/or research designs
    - preprints have become very common

- The share of high-quality studies based on credible research designs is surprisingly small
    - Use of randomized control trials (RCTs) and quasi-experimental designs have been relatively rare
    - Yet, things are improving over time!

Benefits and costs of COVID-19 policies

- We need more high-quality studies on the effectiveness of various governmental policies and restrictions to mitigate the epidemic

  - Information on the effects of policies is useful also for the future pandemics

- If there is evidence that certain policies can reduce infections effectively with respect to their costs, we should prioritize those policies

- Yet, it is also important to account for various indirect costs that policies can create

DID approach in evaluating COVID-19 policies

Using Difference-in-Differences to Identify Causal Effects of COVID-19 Policies

Andrew Goodman-Bacon, Jan Marcus

May 11, 2020

Abstract

Policymakers have implemented a wide range of non-pharmaceutical interventions to fight the spread of COVID-19. Variation in policies across jurisdictions and over time strongly suggests a difference-in-differences (DD) research design to estimate causal effects of counter-COVID measures. We discuss threats to the validity of these DD designs and make recommendations about how researchers can avoid bias, interpret results accurately, and provide sound guidance to policymakers seeking to protect public health and facilitate an eventual economic recovery.

Keywords: difference-in-differences, non-pharmaceutical interventions, COVID-19, causal inference

Main challenges in evaluating COVID-19 policies

- There are several reasons why evaluating the effectiveness of various policies is challenging

    - Reverse causality: policies are often responses to epidemic situation
    - Several policies or restrictions are often set/relaxed simultaneously
    - Either there is no control group for certain policy or the control group is too different
    - Voluntary pre-cautionary behavior
    - Anticipation effects
    - Spillover effects

- Partly due to above reasons many people do not trust observational evidence on certain covid-policies
    - Yet, there are big quality differences on observational designs and studies

Quasi-experimental applications

- Note that it is not enough just to apply certain quasi-experimental method for specific research question.

- In the case of COVID-19, high-quality quasi-experimental applications should be

  - transparent (state assumptions and choices made)
  - convincing (show that the strategy works and test/check main assumptions)
  - based on high-quality data
  - timely and policy-relevant

Effects of school closures

- Large number of countries closed schools due to COVID-19 pandemic in spring 2020 and again during academic year 2020-2021

- School closures have been very controversial policies, as they can have detrimental effects on learning and mental health of students (Viner et al. 2021)

- A large number of observational studies have investigated the effects of school closures on
  - COVID-19 infections
  - learning outcomes
  - mental health and other health/welfare outcomes

School closures and COVID-19 infections

- According to recent systematic reviews (e.g. Walsh et al. 2021) as well as several quasi-experimental studies, school closures are not very effective in reducing COVID-19 infections.
  - Yet, in difficult pandemic situation school closures can reduce infections

- Vlachos et al. (2021, PNAS) found evidence that closures of upper secondary schools in Sweden decreased the incidence of infections for parents of upper secondary school students and teachers and their spouses.

- On the other hand, Godoy et al. (2021) showed that in Norway reopening of high schools did not increase COVID-19 infections for students or parents in spring 2020.
  - Similar results have been found for Germany based on similar design (DID)

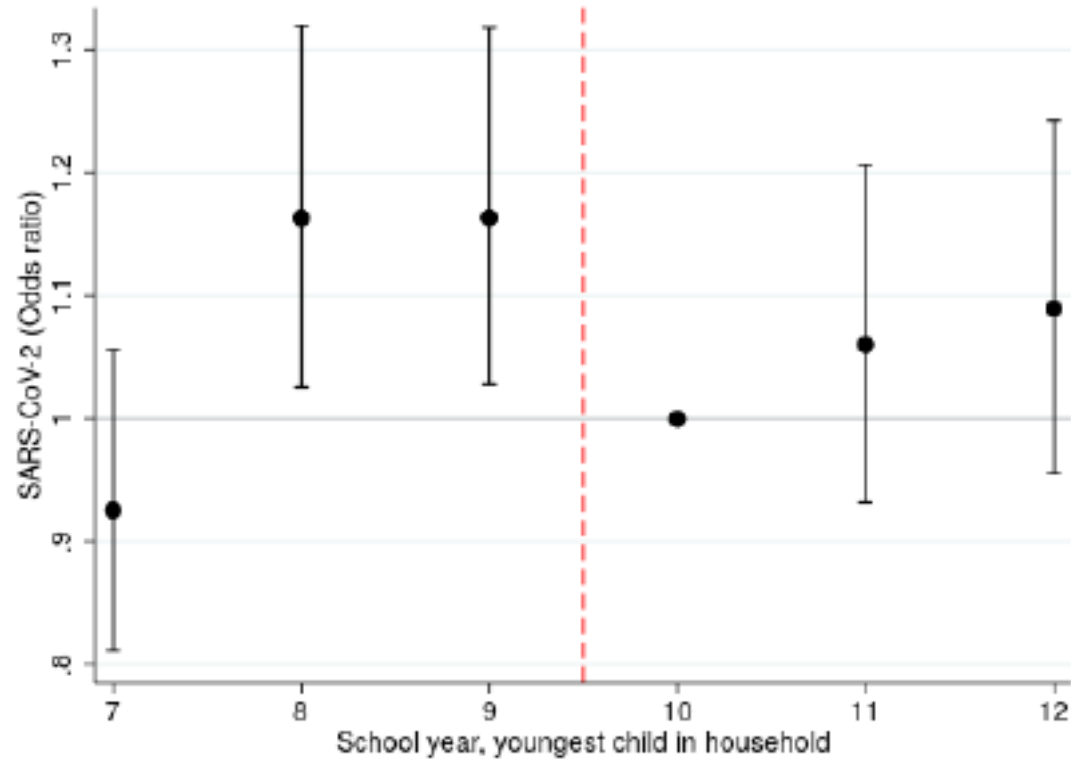# Vlachos et al. (2021, PNAS): RDD-style comparison

Fig. 2: SARS-CoV-2 odds ratios for parents by school year of the youngest child in the household. Odds ratios estimated using logistic regression. The reference category is school year 10 and 95% confidence intervals are indicated.
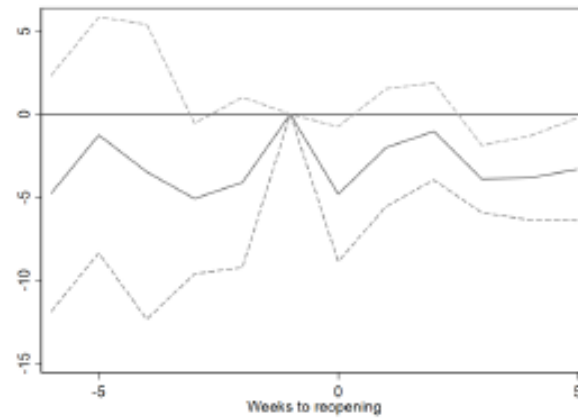
Godoy et al. (2021): DID & event study design

Figure 2: Event study of school reopening on COVID-19 infections by estimation sample
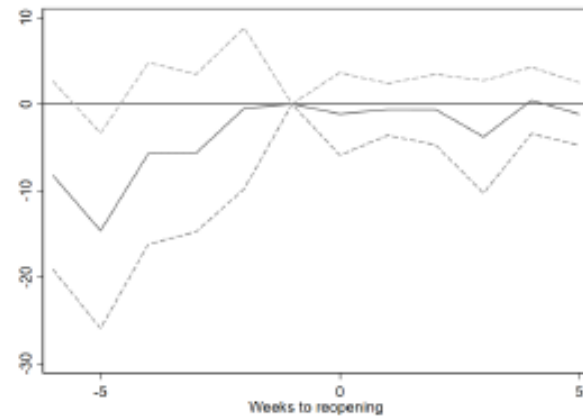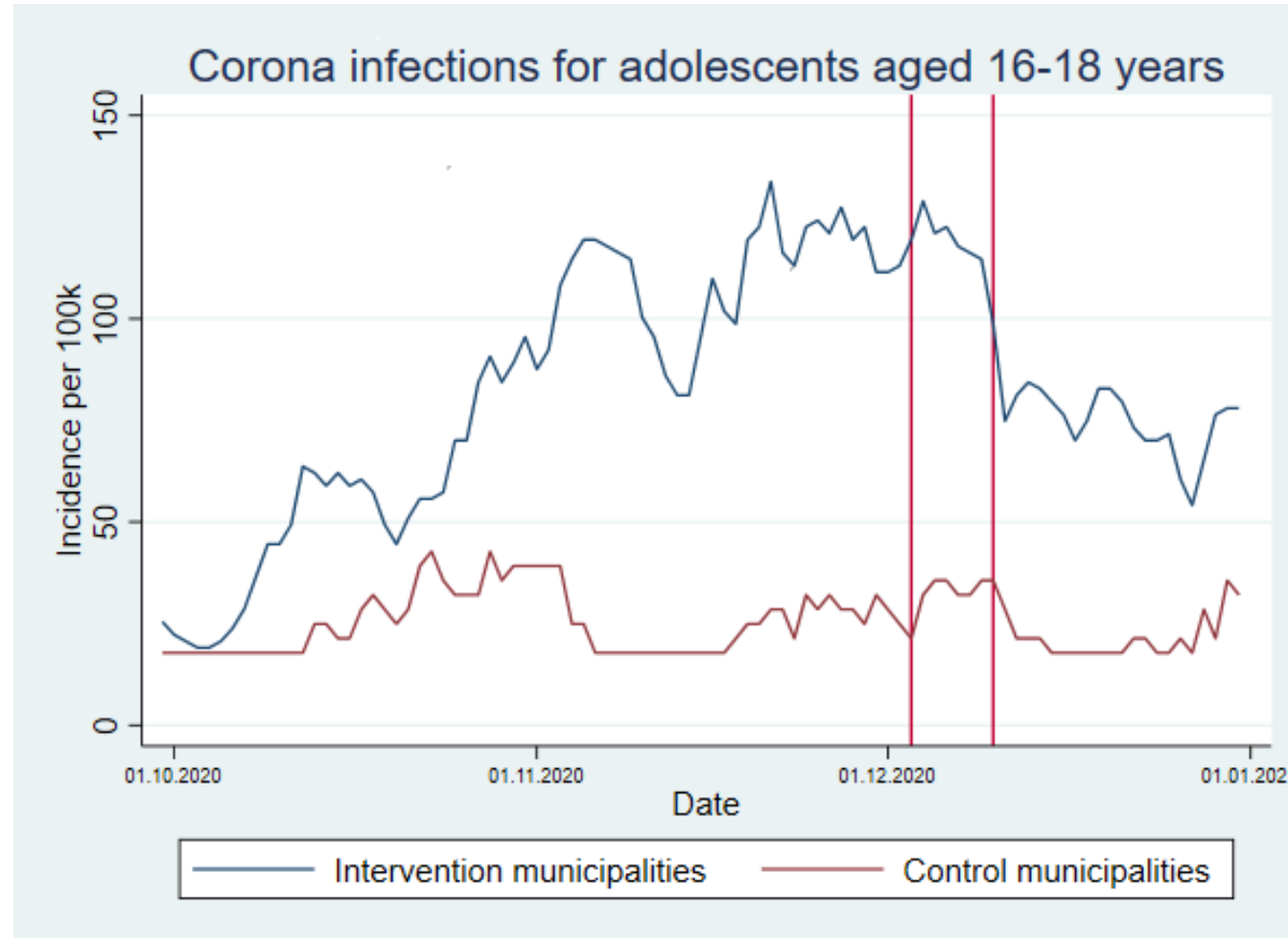

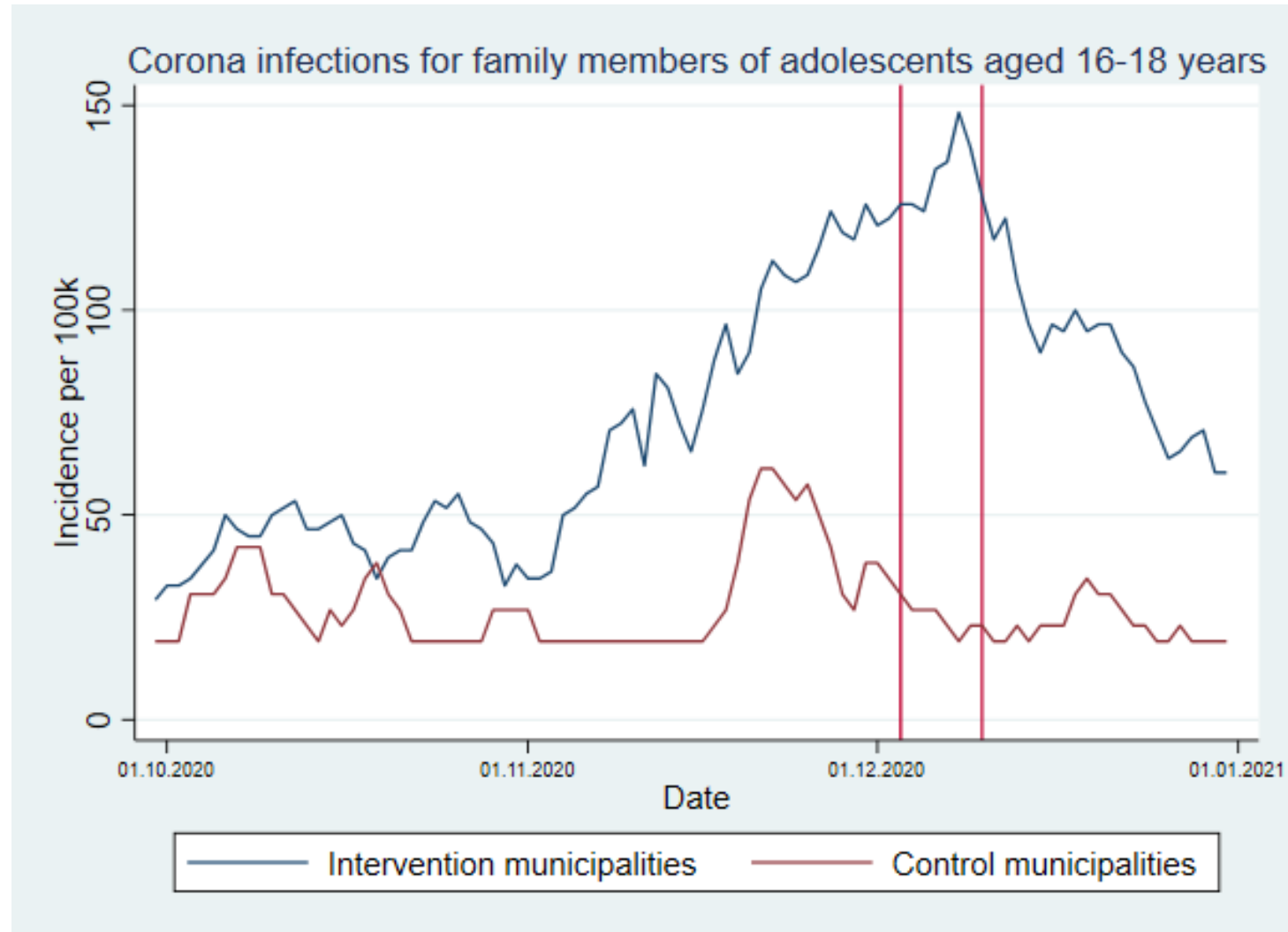(a) Students
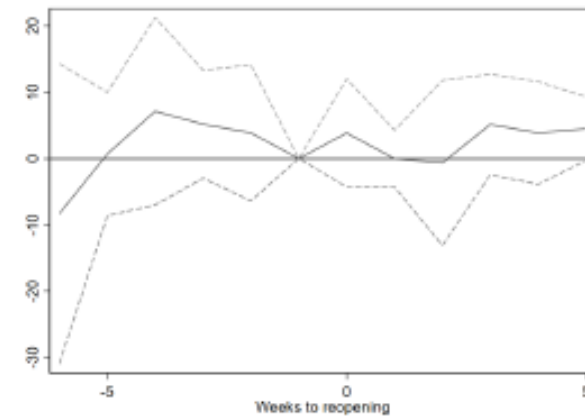
(b) Parents

(c) Professionals

Effect of school closures on COVID-19 infections in Finland

- In one of our reports (Kortelainen et al. 2021) in the Helsinki GSE COVID-19 Situation Room, we studied the effect of upper secondary school closures on COVID-19 infections.

- We use two identification strategies based on regional and age variation of policies (natural experiments):
    1. Compare municipalities that closed schools in November/December 2020 to municipalities that did not close schools (DID)
    2. Compare different age cohorts in treatment municipalities (youths aged 16-18 vs. 13-15 years) (RDD)

- We study the effect of school closures on COVID-19 infections of students and their family members.
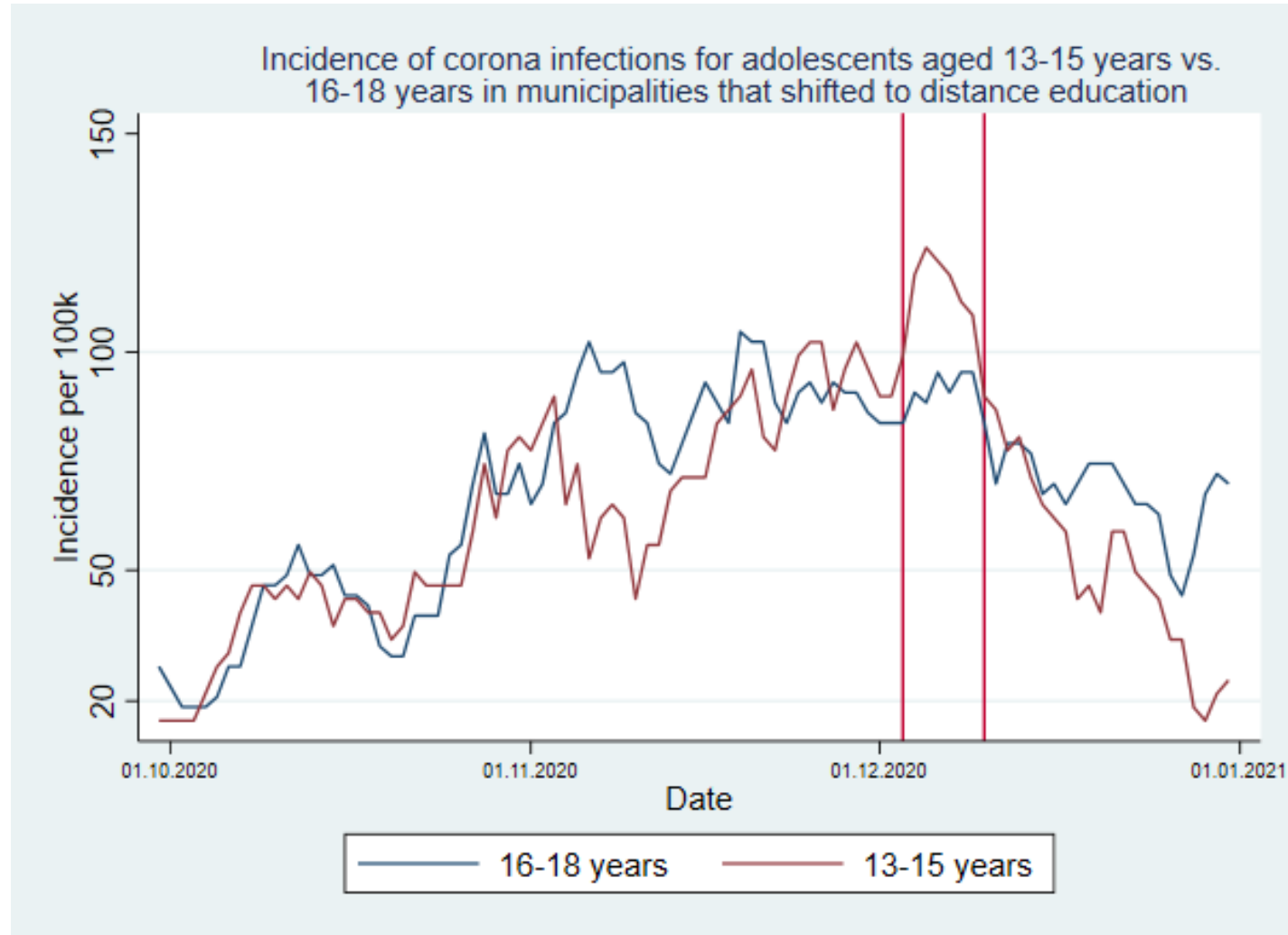
Regional comparison: Students

Corona infections for adolescents aged 16-18 years

Regional comparison: Family members

Corona infections for family members of adolescents aged 16-18 years

Comparison of age cohorts in treatment municipalities

Incidence of corona infections for adolescents aged 13-15 years vs. 16-18 years in municipalities that shifted to distance education

# Effects of school closures on learning outcomes

- One important indirect cost for school closures are their potential effects on learning and mental health of students
  - longer-run costs still difficult to evaluate (Viner et al. 2021)

- There is recent quasi-experimental evidence on short-term learning losses at least from two countries
  - Netherlands: Engzell et al. (2021, PNAS) (DID)
  - Belgium: Maldonado & De Witte (2020) (panel FE)

- Above studies found distance education to decrease learning and increase socioeconomic inequalities in learning outcomes

Effects of school closures: other outcomes

- Takaku & Yokoyama (2021, JPubEcon) used RDD to evaluate the effect of elementary school closures on children and family well-being

- Their identification strategy exploits the discontinuity in the probability of going to school at a certain threshold of age in months
  - Comparison group: pre-school students not affected by school closures

- They find
  - Increase in children's weight and mothers' anxiety over how to raise children
  - No statistically significant effect on the incidence of domestic violence and the quality of marriage

Fuzzy RDD

(a) Preschool & School Closure (As of March 2020)
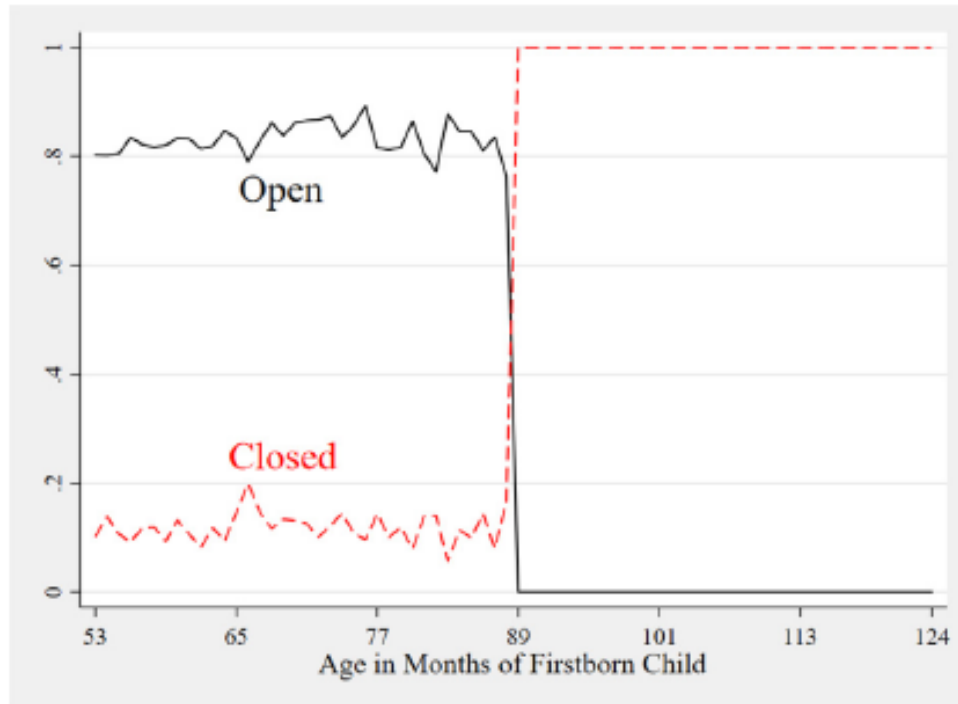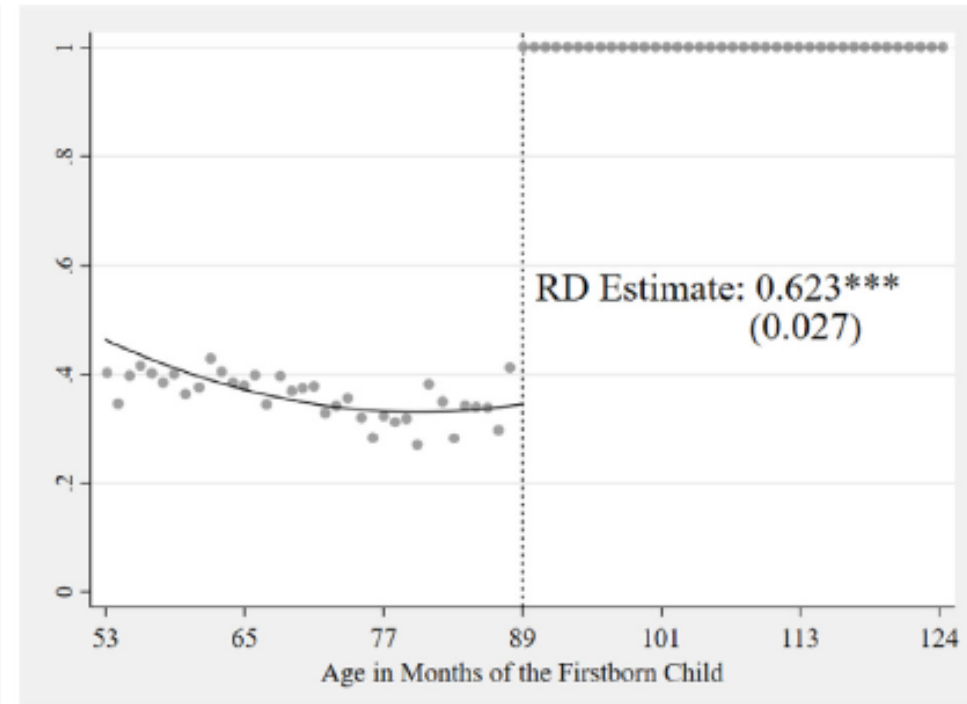
(b) Impacts on Probability of "Non-Schooling"

RD Estimate: 0.623***
(0.027)

Fig. 1. The Impact of School Closures on "Non-Schooling". *Notes:* The childcare facilities that were available as of March 15, including those with requests for voluntary restraint in the use of the childcare facility, are categorized as "Open" in Fig. 1(a). In Fig. 1(b), observations are averaged within bins using the mimicking variance evenly-spaced method described in Calonico et al. (2015). Fig. 1(b) also includes second-order global polynomial fits represented by the solid lines. The estimate reported inside the figure is a sharp-RD estimate obtained from the conventional local-linear regressions. Conventional heteroskedasticity-robust standard errors are reported in parenthesis. The CCT bandwidth selector proposed by Calonico et al. (2014) is used to calculate the optimal bandwidth. The same bandwidth is applied to the areas below and above the cutoff. A triangular kernel function is used to construct the estimators. The selected optimal bandwidth is 9.634, and the number of observations within the bandwidth is 4,003. *** $p<0.01$, ** $p<0.05$, and * $p<0.1$.
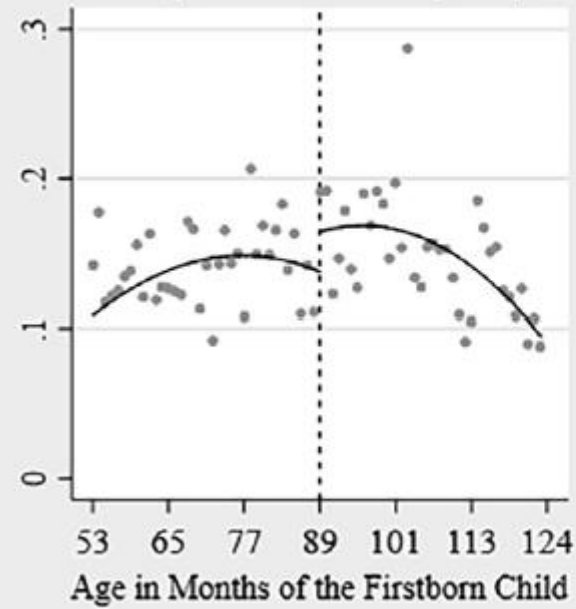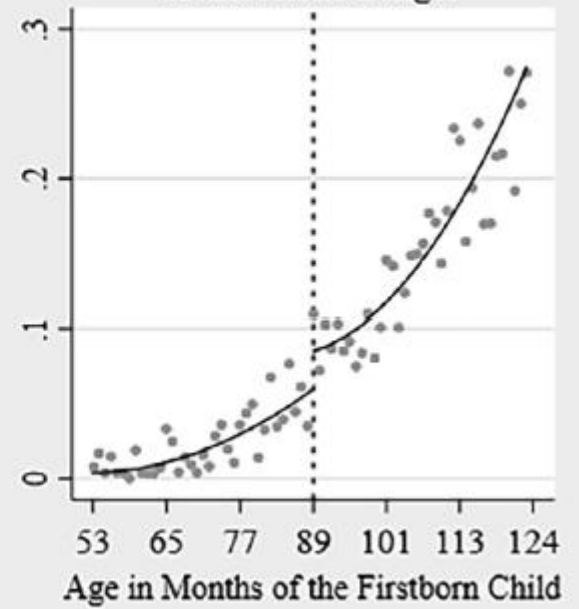
Health/welfare outcomes
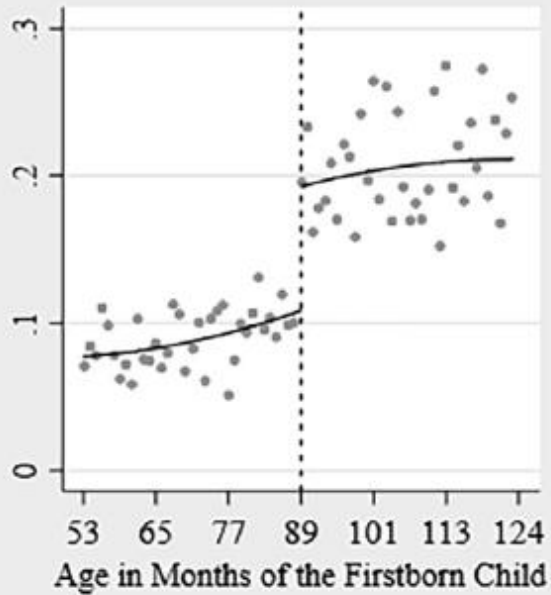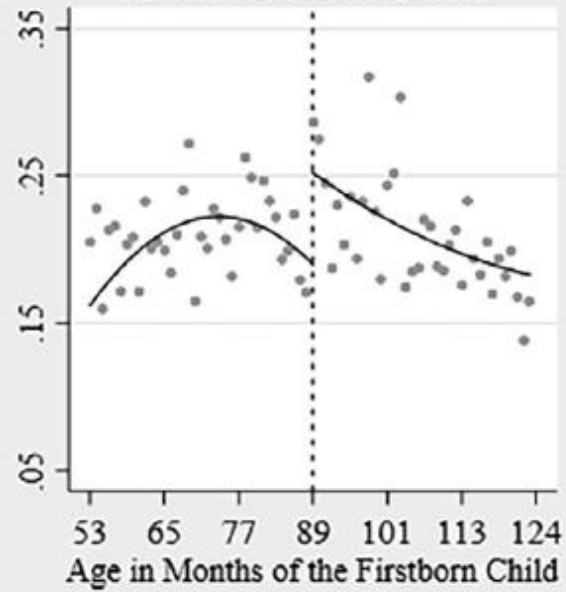
Effects of stay-at-home orders on mental health

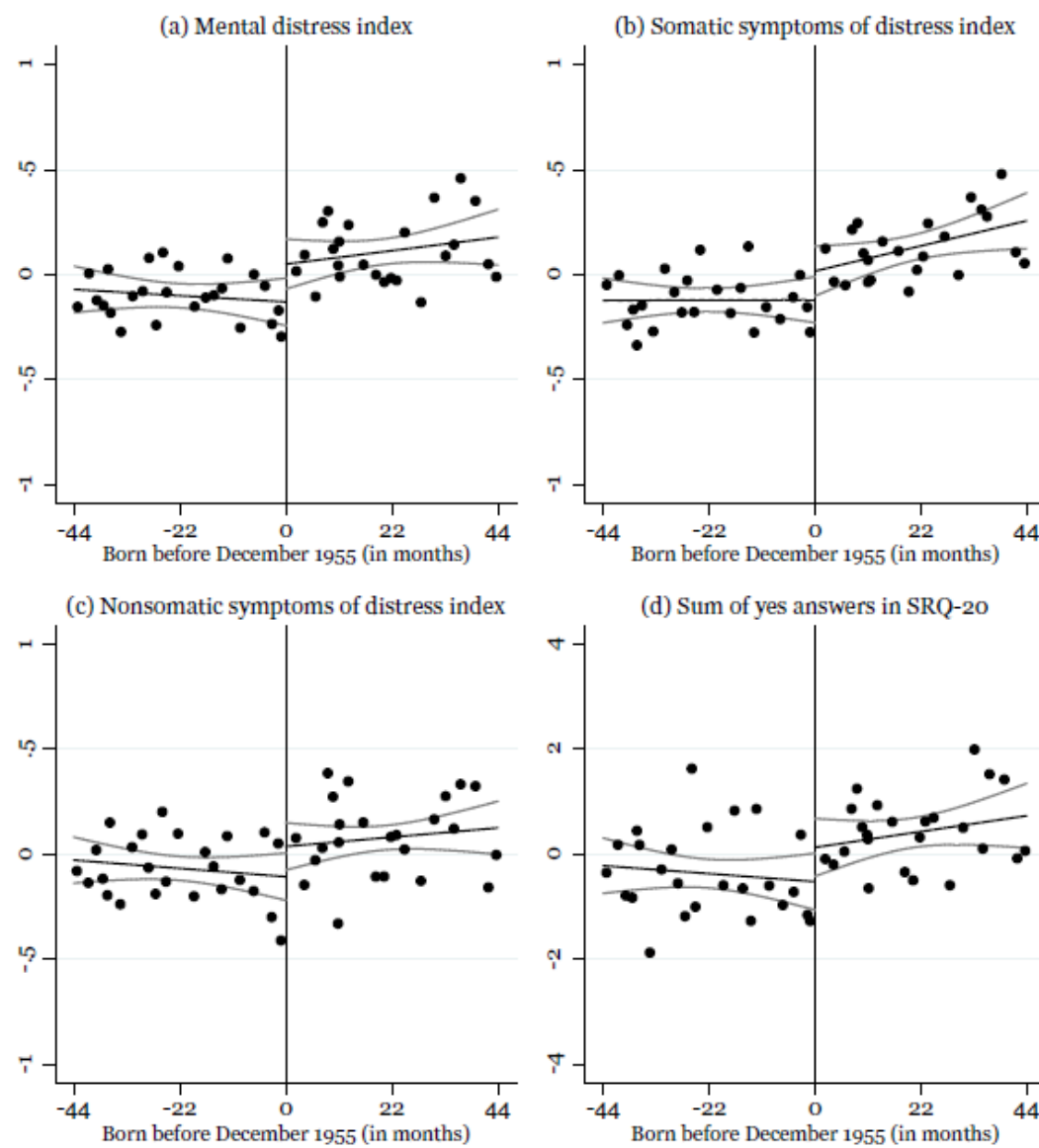- Recently, Altindag et al. (2021, AEJ:AE) studied the effects of age-specific lockdown order for adults aged 65 and older in Turkey
  - Convincing RDD evidence

- Their identification strategy compares seniors aged just over 65 to seniors just under 65
  - Age is running variable in RDD

- They look at how strict stay-at-home-order affected mobility and mental health outcomes of adults aged 65 and over.

FIGURE 2: RD TREATMENT EFFECTS ON MOBILITY OUTCOMES

(a) Days outside last week

(b) Under curfew

(c) Never goes out
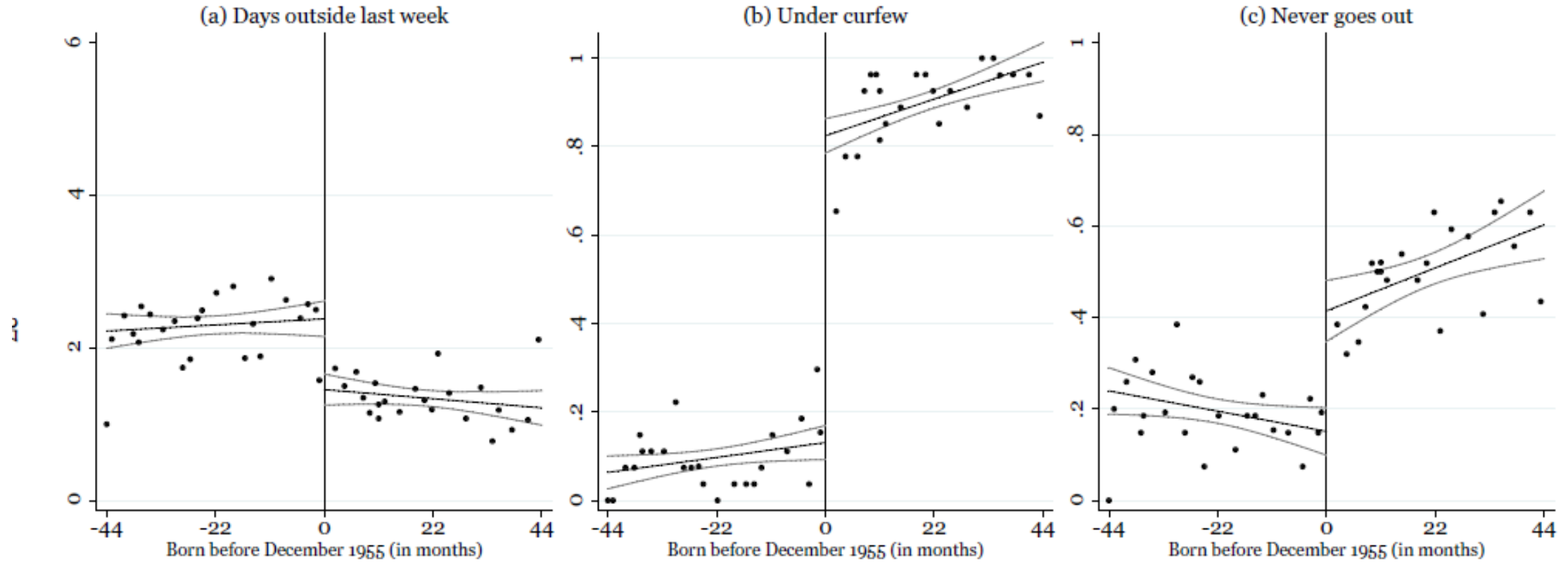
Note: The figures plot the non-residualized values of the number of days spent outside last week, the probability of being subject to the curfew, and the probability of never going outside against the month-year of birth of being born in December 1955. The sample includes all individuals born before and after 44 months around the cutoff point, December 1955. The vertical line in each graph represents the cut-off point, December 1955. Gray lines show 95 percent confidence intervals around the mean level. Variable definitions are listed in Appendix B.

FIGURE 3: RD TREATMENT EFFECTS ON MENTAL HEALTH OUTCOMES

(a) Mental distress index

(b) Somatic symptoms of distress index

(c) Nonsomatic symptoms of distress index
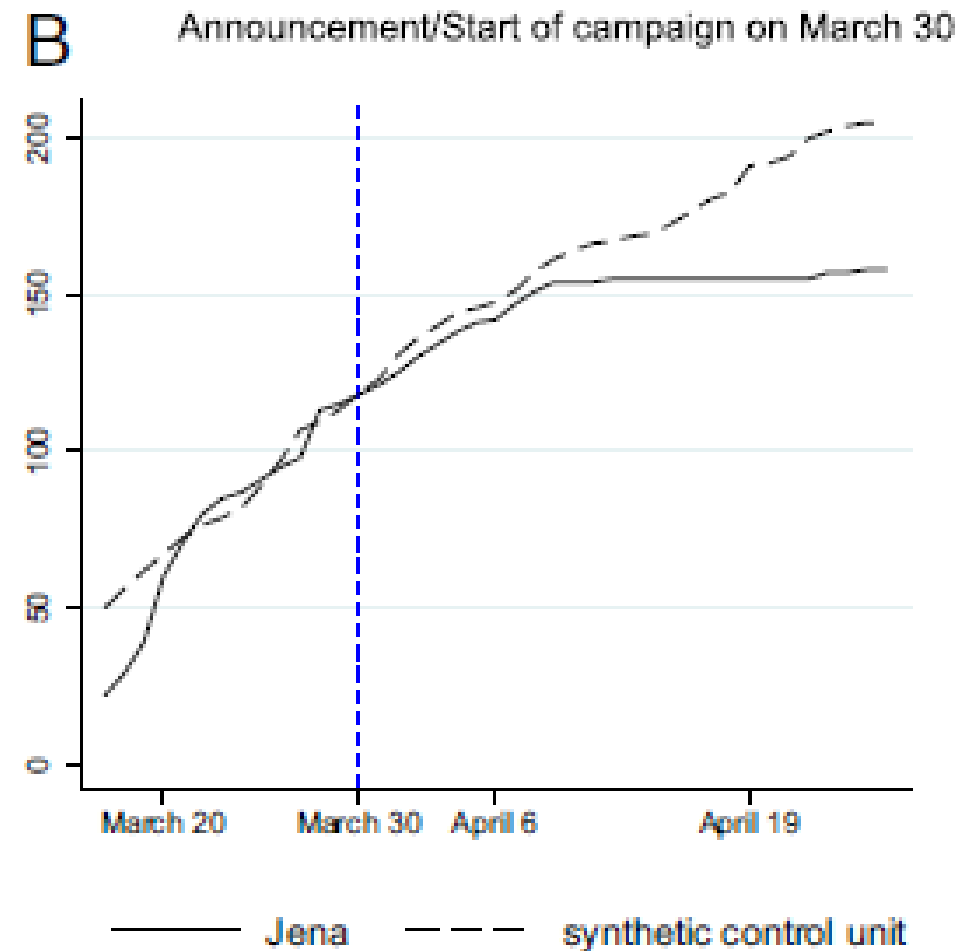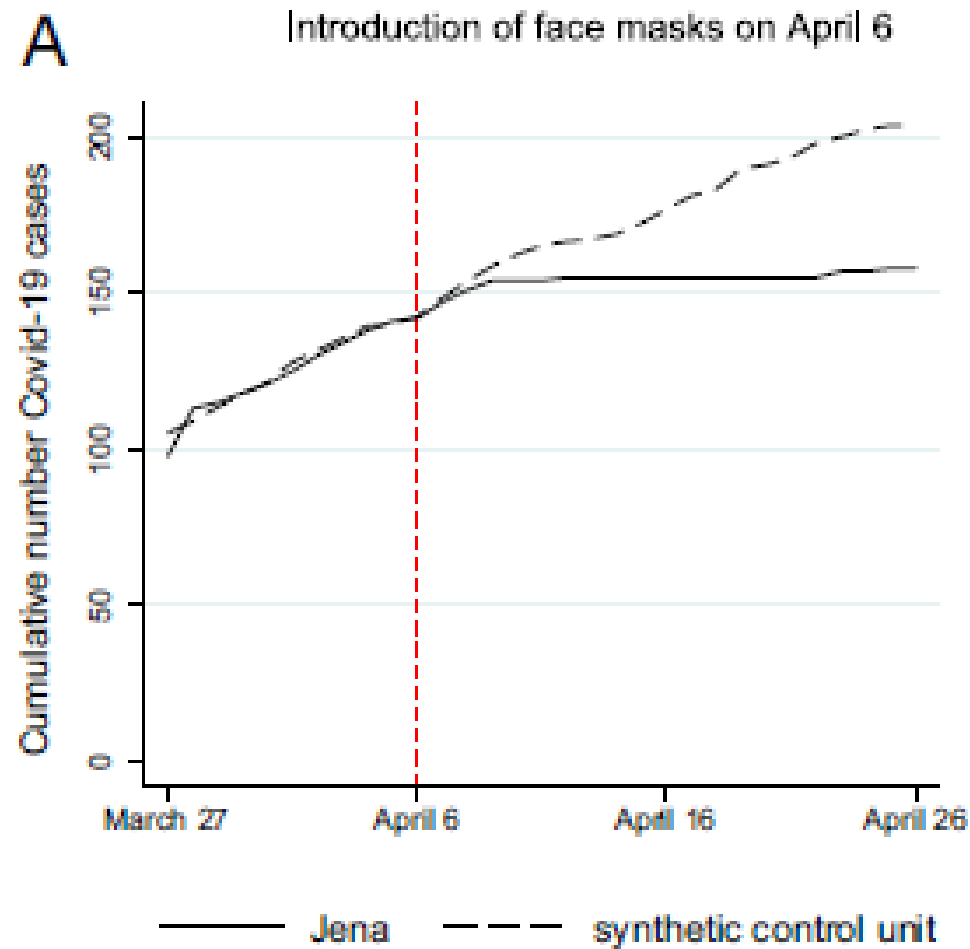
(d) Sum of yes answers in SRQ-20

Effectiveness of masks

- Perhaps the most controversial COVID-19 policy has been the recommendations to use masks and mask mandates
  - Critical discussion also in Finland

- So far there is no convincing RCT evidence on the effects of masks on COVID-19 infections
  - Credible RCTs difficult to implement, especially in bad epidemic situation
  - Abaluck et al. (2021) are using cluster-randomized RCT in Bangladesh

- A large number of observational studies (see Brooks et al. 2021 JAMA) have been published and some of them utilize quasi-experimental methods:
  - Mitze et al. (2020, PNAS)
  - Chernozhukov et al. (2021, JoE)

Mitze et al. (2020, PNAS)

- Mitze et al. (2020) used the synthetic control method to analyze the effect of face masks on the spread of COVID-19 in Germany

- Their identification approach exploits regional variation in the point in time when wearing of face masks became mandatory in public transport and shops
  - case study: Jena

- They found face masks to reduce the number of newly registered COVID-19 infections between 15% and 75% over a period of 20 days after their mandatory introduction

Effects of face masks on Covid-19 cases in Jena

A — Introduction of face masks on April 6

B — Announcement/Start of campaign on March 30

Cumulative number Covid-19 cases

Jena — synthetic control unit

Chernozhukov et al. (2021, JoE)

- Chernozhukov et al. (2021) studied the effects of different policies on COVID-19 infection in the US in spring 2020
  - Counterfactual approach based on state and time variation in policies

- They study the effects of restaurant closures, stay-at-home-orders, mask mandates and school closures.

- They found that nationally mandating face masks for employees early in the pandemic could have reduced
  - the weekly growth rate of cases and deaths by more than 10 percentage points in late April
  - 19 to 47 percent less deaths nationally by the end of May, which roughly translates into 19 to 47 thousand saved lives.

Effectiveness of COVID-19 policies

- What kind of evidence there is on the effectiveness and cost-effectiveness of policies and interventions?
  - Studies based on RCTs and quasi-experimental research designs

- Effective/cost-effective policies:
  - COVID-19 vaccination (most cost-effective policy!)
  - COVID-19 testing
  - Mask mandates

- Less effective policies or policies with high costs
  - School closures