The Impact of Face-Mask Mandates on All-Cause Mortality in Switzerland: A Quasi-Experimental Study

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Abstract

Background: Whereas there is strong evidence that wearing a face mask is effective in reducing the spread of SARS-CoV-2, evidence on the impact of face-mask mandates on deaths from coronavirus disease 2019 (COVID-19) and all-cause mortality is sparse. Understanding the impact of face-mask mandates can inform policy makers on the most effective policy options at different stages of the COVID-19 pandemic and inform policy during possible future epidemics caused by similar viruses.

Objective: Focusing on a unique quasi-experimental setting in Switzerland and all-cause mortality as the primary outcome (with COVID-19 cases and deaths serving as secondary outcomes), we aimed to determine i) the effect of face-mask mandates for indoor public spaces; ii) how the effect has varied over time, and by age and sex; and iii) the effect of adding contact tracing and stricter social distancing rules to face-mask mandates.

Methods: Our analysis exploits the fact that between July and October 2020, nine cantons in Switzerland extended a face-mask mandate at different time points from being restricted to public transportation only to applying to all public indoor places. We used both a Difference-in-Differences approach with fixed-effects for canton and week and an event-study approach.

Results: In our main Difference-in-Differences model, the face-mask mandate was associated with a 0.3% reduction in all-cause mortality (95% CI: -3.4% to 2.7%; p=0.818). This small non-significant effect was confirmed in the event-study approach and a variety of robustness checks. We did not find any evidence for substantial effect heterogeneity by sex, age, or time since implementation of the policy. Neither did we identify significant effects of the face-mask mandate on COVID-19 cases and deaths. Combining the face-mask mandate with social distancing rules led to an estimated 5.1% (95% CI: -7.9% to -2.4%; p=0.001) reduction in all-cause mortality compared to implementing neither a face-mask mandate nor contact tracing and social-distancing rules.

Conclusion: Mandating face-mask use in public indoor spaces in Switzerland in mid- to late 2020 does not appear to have resulted in substantial reductions in all-cause mortality.

There is some suggestion that combining face-mask mandates with social distancing rules led to a small reduction in all-cause mortality.

Introduction

Since the beginning of the coronavirus disease 2019 (COVID-19) pandemic, governments have resorted to several non-pharmaceutical interventions (NPIs) in their response to COVID-19 including social distancing rules, contact tracing, face-mask mandates, and partial or total lock-downs. Despite the rollout of vaccines, NPIs still remain a commonly implemented policy tool for COVID-19 in 2021. However, after almost two years since the start of the pandemic, there is still debate on which combination of NPIs is most effective in preventing overburdening of the health system and reducing morbidity and mortality (Mei, 2020).

Especially since the release of a preprint in late August 2021 that reports on a large-scale cluster-randomized trial of community-level face-mask promotion in rural Bangladesh (Abaluck et al., 2021), there is wide scientific consensus that face masks are effective in reducing the spread of SARS-CoV-2. While the effectiveness of face masks themselves has been convincingly demonstrated (Abaluck et al., 2021; Howard et al., 2020; Leung et al., 2020; Macintyre and Chughtai, 2015; Bundgaard et al., 2021; Leffler et al., 2020; Lyu and Wehby, 2020; Chernozhukov et al., 2021), the effectiveness of face-mask mandates is less certain. The impact of such mandates likely depends on a host of factors including the degree to which the population adheres to the mandate, which population groups adhere more strictly, the type of mask worn, and the dynamics of the epidemic. To date, evaluations of such mandates have largely focussed on their impact on the rate of growth of new cases of SARS-CoV-2 infection and deaths due to COVID-19 (Chernozhukov et al., 2021; Mitze et al., 2020; Lyu and Wehby, 2020; Brauner et al., 2021; Kosfeld et al., 2021; Karaivanov et al., 2020). These outcomes are vulnerable to substantial measurement error including from the degree of testing that is being conducted, attribution of deaths to COVID-19 as opposed to underlying health problems, and variation in the quality of, and access to, healthcare. They also fail to measure the indirect effects of face-mask mandates, such as those deaths that are averted because the mandate reduced demand on hospitals, which as a result may have been able to provide better care to non-COVID-19 patients.

This study is an important new contribution to the existing body of evidence for two main reasons. First, we focus on all-cause mortality as the primary outcome. Unlike COVID-19-specific outcomes, all-cause mortality in our study setting (Switzerland) is recorded highly reliably. Arguably, it is also the health outcome that is of highest importance to society. Nonetheless, to be comprehensive in our approach, we also study the effect of the mandates on COVID-19 cases and deaths. Second, we exploit a unique quasi-experimental setting that enables us to obtain causal effect estimates under weaker assumptions than most existing evaluations. Specifically, our analysis exploits variation in both the timing and geography of face-mask mandates resulting from the fact that public health policies in Switzerland have differed across cantons and have interacted with Federation-wide policies that were instituted at certain time points in the pandemic.

The aims of this study were threefold: to determine i) the effect of face-mask mandates for indoor public spaces on all-cause mortality; ii) how the effect of face-mask mandates on all-cause mortality has varied over time, and by age and sex; and iii) the effect of adding contact tracing and stricter social distancing rules to face-mask mandates on all-cause mortality. In secondary analyses, we also examine the effect of the mandates on new cases of COVID-19 and deaths due to COVID-19.

Methods

Study Setting and Policy Environment:

Two key aspects of COVID-19 policies in Switzerland are instrumental to our analysis. First, over the initial months of the pandemic, the different cantons had substantial autonomy over the Swiss Federal Council. As a result, public health policies differed across cantons. Thus, throughout the paper we distinguish between federal and cantonal policies. The former were imposed by the Swiss Federation and applied to all cantons, while the latter were decided by a specific cantonal authority and accordingly enforced within the canton only. Secondly, on July

6, 2020, the Federation mandated face-mask wearing on public transportation. Then, between July and October 2020, nine cantons extended face-mask requirements to all public (indoor) places, e.g., supermarkets, stores, and restaurants. This study is concerned with ascertaining the causal effect of extending face-mask requirements to these additional locations. Finally, on October 18 2020, the Federation applied the face-mask requirement to all public indoor spaces in the whole country. Text S1 and Figures S1 and S2 provide more details on these policies and their timing.

Data Sources and Primary Outcome

Our analysis is based on a longitudinal dataset at the canton-week-year level. The dataset comprises observations for the 26 Swiss cantons in the first 40 weeks of each year between 2012 and 2020. We chose 40 weeks (rather than 42 weeks) as the study length because we assumed a minimum of two weeks for the first effects of a face-mask mandate to be observable. Five cantons implemented face-mask mandates after these 42 weeks but prior to October 18 2020 (October 10th for Zug and Ticino, October 12th for Bern, and October 17th for Grischun and Luzern).

To construct the policy timeline, we used information from newspaper articles and cantonal official internet web pages. Data on total deaths and population were obtained from the Federal Statistical Office website (FSO - Cause of Death Statistics, 2021). These data disaggregate deaths by sex and five-year age groups. We grouped age into four categories (0-29 years, 30-59 years, 60-89 years; and 90+ years). Using this information, we computed the main outcome of interest as:

$$Log(Y_{cwts}) = Log\left(\frac{\sum_{a=1}^{4} Deaths_{cwts}}{\sum_{a=1}^{4} Population_{c(t-1)s}} * 100{,}000\right) \quad (1)$$

where, Y_{cwts} represents the all-cause mortality in canton c, in week w and year t for sex s. The aggregate number of male (female) deaths was weighted by the canton's male (female) population in the previous year (t -1). This adjustment allows us to take into account i) the different population sizes of cantons, ii) cantonal demographic characteristics, and iii) growth and aging of the population over time. We use the logarithm of all-cause mortality such that the regression coefficients can be interpreted as an approximation of the percentage change in the outcome with every one unit change in the explanatory variable.

When examining how effects vary by age and sex, we computed four different outcomes for each age category and sex as follows:

$$Log(Y_{cwtsa}) = Log(\frac{Deaths_{cwtsa}}{Population_{c(t-1)sa}} * 100{,}000) \quad (2)$$

Now, Y_{cwtsa} represents the deaths per population in canton *c*, in week *w* and year *t*, for a specific sex *s* and age cohort *a*. We show descriptive statistics of all-cause mortality by age and sex at the national level and by canton in the appendix (Table S1 and S2).

Secondary Outcomes

Our secondary outcomes are new COVID-19 cases per week and new deaths from COVID-19 per week. Data on these outcomes were obtained from the Statistical Office of the Canton of Zurich (Kanton Zürich Statistisches Amt, 2020). COVID-19 cases and deaths were not disaggregated by sex and age category because this information was not available for all cantons. The Federal Council did not instruct cantons on the definition of COVID-19 cases and deaths (Meier, C., 2020). All cantons apart from the Geneva canton, however, confirmed that preliminary diagnoses were counted as cases. Starting on March 9, 2020, the Federal Council advised testing only for i) individuals with severe symptoms, and ii) individuals at high risk of complications or in direct contact with patients or residents of retirement and nursing homes. On April 27, 2020, the Federal Office of Public Health additionally recommended testing individuals with symptoms suggestive of an acute respiratory disease, muscle pain, or loss of smell or taste.

Statistical Analysis

To identify the causal effect of face-mask mandates on our outcomes, we employ a Difference-in-Differences model with fixed effects and an event study. Below, we describe the analyses for all-cause mortality. The approach employed for our secondary outcomes (COVID-19 cases and COVID-19 deaths) was identical to the one used for all-cause mortality. In our research design, a *Treated* canton has a mandate of mask wearing in all public indoor spaces while a *Control* canton has compulsory mask wearing on public transport only. Following Solon et al., (2015), we conduct our analyses using cantonal population size as analytic weights.

Difference-in-Differences Analysis

We estimated the following equation:

$$log(Y_{cwt}) = \alpha_0 + \beta_0 Treat_c + \beta_1 Post_{wt} + \beta_2 Did_{cwt} + \gamma_c + \theta_w + \tau_t + \varepsilon_{cwt} \quad (3)$$

with *Treat* being a binary variable indicating whether the canton had adopted the face-mask mandate; and *Post* a binary variable taking a value of 1 in the post-mandate period (and 0 otherwise). *Did* is the interaction between *Treat* and *Post*. Our parameter of interest is β_2. Finally, γ_c, θ_w and τ_t are, respectively, binary variables for canton, week, and year. The key identifying assumption of Difference-in-Differences analyses is that of common trends between treated and control cantons in the absence of the treatment. Figures S8-S13 indicate that this assumption is plausible given that treated and control cantons have parallel trends prior to implementation of the face-mask mandate.

Importantly, we set a unique starting date for the post-mandate period for all cantons on July 7. This allows us to eliminate likely anticipation bias due to behavioural responses. For example, people in cantons that implemented the policy at a later date may have decided to wear a face mask in indoor places prior to the canton's face-mask mandate. However, attributing the treatment earlier than the actual date of adoption in some cantons might lead to a downward estimated coefficient. In practice, to an extreme, this would consider as treated some cantons that would be controls at that point. Thus, we test whether this attenuation is relevant in the event-study analysis, and in a staggered Difference-in-Differences analysis, which uses the actual date of policy implementation (see Table S11-S15, and Text S4).

Event-Study Analysis

As a complementary approach to the Difference-in-Differences analysis described above, we also implemented a panel-event study, with the date of the "event" being the date of implementation of the face-mask mandate in a particular canton. Formally, we estimated the following equation:

$$log(Y_{cw}) = \alpha_1 + \sum_{j=2}^{J} \delta_j \, (Lag\ j\ )_{cw} + \sum_{k=1}^{K} \lambda_k \, (Lead\ k\ )_{cw} + \mu_w + \psi_c + \varepsilon_{cw} \qquad (4)$$

where ψ_c and μ_w are binary variables for canton and week, and ε_{cw} is an unobserved error term. Further, Lag_j and $Lead_k$ are two binary variables indicating the number of weeks until implementation of the face-mask mandate in canton *c*. Formally, we define Lag_j and $Lead_k$ according to equations (5)-(8):

$$(Lag\ j\ )_{cw} = 1[t \leq Event_c - J]\,, \qquad (5)$$

$$(Lag\ j\ )_{cw} = 1[t = Event_c - j] \ \ for\ j \in \{1, \ldots, J-1\}\,, \qquad (6)$$

$$(Lead\ k\ )_{cw} = 1[t = Event_c + k] \ \ for\ k \in \{1, \ldots, K-1\}\,, \qquad (7)$$

$$(Lead\ k\ )_{cw} = 1[t \geq Event_c + \ K]. \qquad (8)$$

where, $Event_c$ is a variable indicating the week *w* in which the face-mask mandate was implemented in canton *c*. The first *Lag* was omitted to capture the baseline difference between treated and control cantons.

Variation in the Effect of Face-Mask Mandates over Time

To assess how the effects of the face-mask mandate vary with time, we estimated a dynamic model where β can vary across weeks:

$$Log(Y_{cwt}) = \alpha_2 + \beta_0 Treat_c + \sum_{w=27}^{40} \beta_{1w} \ [week_{cw(t=2020)} - week(T=1)_c]$$

$$+ \sum_{w=27}^{40} \beta_{2w} \ Treat_c[week_{cw(t=2020)} - week\ (T=1)_c] + \gamma_c + \theta_w + \tau_t + \varepsilon_{cwt} \qquad (9)$$

$Treat_c$ is a binary variable equal to 1 if canton *c* is ever treated (i.e., implements a face-mask mandate). Then, [$week - week(T = 1)_c$] is the difference between the observation week and the first week of implementation of the extra measure in canton *c*. The parameters of interest are the β_{2w}, which represent the mean difference in the outcome of interest in a specific week *w*. We also control for canton (γ_c), week (θ_w) and year (τ_t) fixed-effects.

Variation in the Effect of Face-Mask Mandates by Age Group and Sex

We first estimated our Difference-in-Differences model (in equation 3) in each age group, controlling for time and canton fixed-effects. Then, we employed a pooled regression, which allows us to explore the contribution of each age group to the aggregate estimate. In particular, we used the youngest age group (0-29) as baseline and estimated the partial effect for the three other age groups.

Impact of Adding Contact Tracing and Social Distancing to Face-Mask Mandates

To assess the impact of adding contact tracing and/or social distancing rules to the face-mask mandates, we defined four mutually exclusive groups of cantons. Group 0 consists of cantons that enacted neither the face-mask mandate nor contact tracing policies or social distancing rules. Group 1 consists of cantons that enacted the face-mask mandate plus contact tracing policies (but not social distancing rules). Group 2 consists of cantons that enacted face-mask mandates and social distancing rules (but not contact tracing policies). Finally, Group 3 consists of cantons that implemented face-mask mandates, contact tracing policies, and social distancing rules. Formally, we estimated the following equation:

$$Log(Y_{iwt}) = \alpha_4 + \sum_{i=1}^{3} \rho_{0i}\, Group_i + \rho_1 Post_{wt} + \sum_{i=1}^{3} \rho_{2i}\, Did_{iwt} + \sigma_c + \xi_w + \phi_t + \varepsilon_{iwt} \qquad (10)$$

where each $Group_i$ is a binary variable indicating whether a canton is in each of the four groups described above. $Post_{wt}$ is a binary variable equalling 1 for the periods after the implementation of the policy. The parameters of interest are the ρ_{2i} for each of the four groups. ρ_{2i} estimates the effect of the policy on group *i* compared to group 0. Did_{iwt} is the interaction between $Group_i$ *and* $Post_{wt}$. Finally, σ_c, ξ_w and φ_t are canton, week, and year fixed-effects.

Results

Effect on All-Cause Mortality using a Difference-in-Differences Analysis

None of our regression model specifications found a significant effect of the face-mask mandate on all-cause mortality (Table 1). The point estimate was -0.003 in all regression model specifications, with the 95% confidence interval (CI) ranging from -0.034 to 0.027. Interpreting the regression coefficient as an approximation of the percentage change in the outcome, the point estimate, thus, corresponds to a 0.3% decrease in all-cause mortality, with the 95% CI ranging from -3.4% to 2.7%. The effects remained non-significant when examining all-cause mortality separately by sex (further confirmed by a pooled regression on sex [Table S10]). These effect estimates were similar when assigning the same weight to each canton instead of weighting by a canton's population size (Table S23).

Table 1. Results of the Difference-in-Differences regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Male	Male	Male	Female	Female	Female	Total	Total	Total
Treat	-0.070	-0.009***	-0.009***	-0.055	0.066***	0.066***	-0.063	0.026***	0.026***
	(0.049)	(0.001)	(0.001)	(0.055)	(0.001)	(0.001)	(0.051)	(0.001)	(0.001)
Post	-0.046**	-0.045**	0.010	-0.116***	-0.115***	-0.024	-0.082***	-0.081***	-0.007
	(0.018)	(0.018)	(0.026)	(0.013)	(0.014)	(0.018)	(0.013)	(0.013)	(0.020)
DiD	-0.031	-0.031	-0.031	0.024	0.024	0.023	-0.003	-0.003	-0.003
	(0.020)	(0.020)	(0.021)	(0.021)	(0.021)	(0.021)	(0.015)	(0.015)	(0.015)
Constant	2.705***	2.617***	2.697***	2.741***	2.622***	2.778***	2.733***	2.625***	2.744***
	(0.041)	(0.001)	(0.014)	(0.045)	(0.001)	(0.017)	(0.042)	(0.001)	(0.012)
Observations	9,168	9,168	9,168	9,178	9,178	9,178	9,329	9,329	9,329
R-squared	0.021	0.190	0.286	0.016	0.225	0.371	0.026	0.291	0.462
Year FE	NO	NO	YES	NO	NO	YES	NO	NO	YES
Canton FE	NO	YES	YES	NO	YES	YES	NO	YES	YES
Week FE	NO	NO	YES	NO	NO	YES	NO	NO	YES
Mean	2.686	2.686	2.686	2.719	2.719	2.719	2.708	2.708	2.708

Note: Results of regression based on Equation (3); weighted using population as analytical weights. Column 1-2-3 contain observations for male population. Columns 4-5-6 contain observations for the female population. Column 7-8-9 contain observations for aggregate male and female population. S.E. clustered at a canton level (*** p<0.01, ** p<0.05, * p<0.1). Period of estimation: between January 2012 and October 4, 2020. *Treated* cantons are those that between July 7 and October 4 have imposed any mask requirement other than Federal indications (e.g., in supermarkets, restaurants, open space): BS, FR, GE, JU, NE, SO, VS, VD, ZH. *Post* is equal to 1 for all cantons after July 7.

Effect on All-Cause Mortality using an Event-Study Analysis

In line with the findings of the Difference-in-Differences analysis, the event-study analysis found no significant effects of the face-mask mandate on all-cause mortality (Figure 1), neither for the whole population nor when examining men and women separately. There was no indication that the effect of the face-mask mandate varied depending on the number of weeks since it had been implemented.

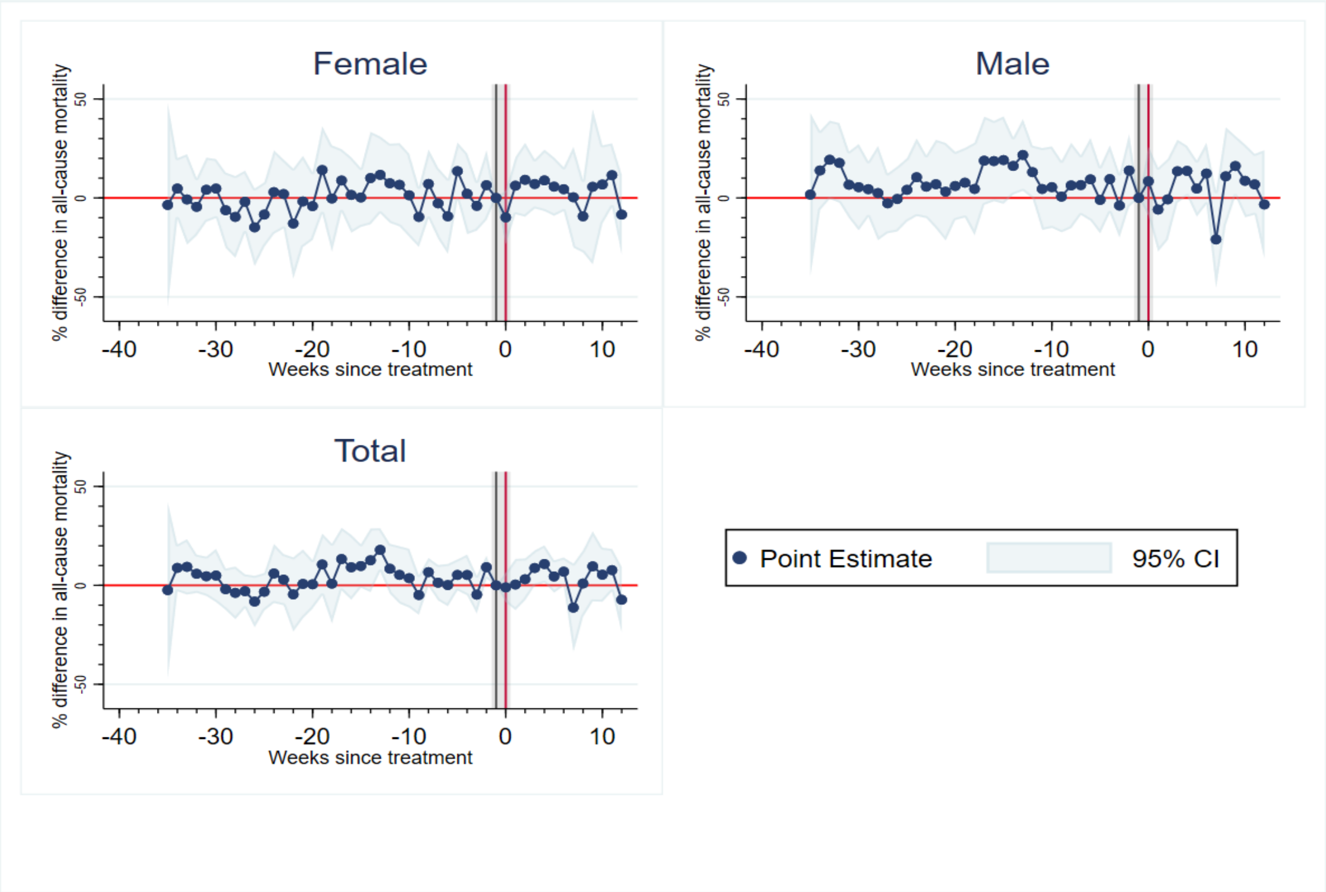

Figure 1. Effect of the face-mask mandate on all-cause mortality using an event-study approach.

Notes: Estimates of Equation (4), weighted using population as analytical weights. Point estimates (blue points) are displayed along with their 95% confidence intervals (light blue area). The percentage difference in all-cause mortality is approximated by the log. Baseline period for the analysis: 1 week prior to implementation of the face-mask mandate in each canton, indicated by the grey vertical line in the plot.

Variation in the Effect of Face-Mask Mandates on All-Cause Mortality over Time

Similar to the event-study approach, our analysis using a Difference-in-Differences approach with a dynamic beta-coefficient found no clear patterns of variation in the effect of the face-mask mandate by the number of weeks since the mandate's implementation (Figure 2).

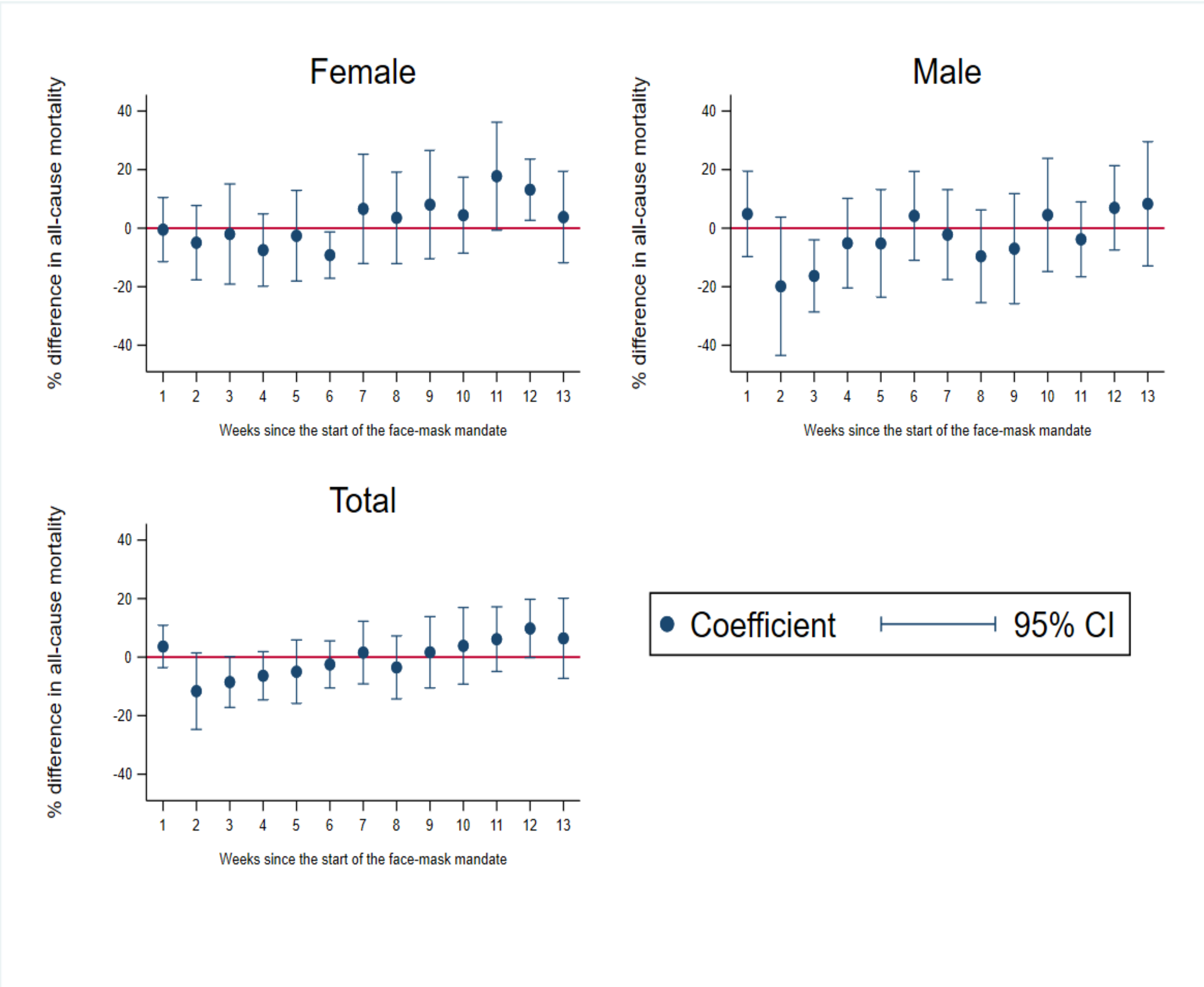

Figure 2. Variation in the effect of the face-mask mandate by time since implementation

Note: Blue dots are the estimated β_2 in week w as in Equation (9), weighted using population as analytical weights. The percentage difference in all-cause mortality is approximated by the log. Week 1 is the first week after the treatment, until the 13^{th} week. Outcome defined as Equation 1. Each vertical bar represents the respective 95% confidence interval.

Variation in the Effect of Face-Mask Mandates on All-Cause Mortality by Age

None of our analytical approaches – neither the Difference-in-Differences design, event-study approach, nor the Difference-in-Differences approach with dynamic beta-coefficients – found any evidence of variation in the effect of the face-mask mandate by age group (Figure 3, Appendix Table S3-S9, S12-S15, S17-20, Appendix Figure S3-S7). Figure 3 shows that there is neither any evidence of differential effects over time by age group.

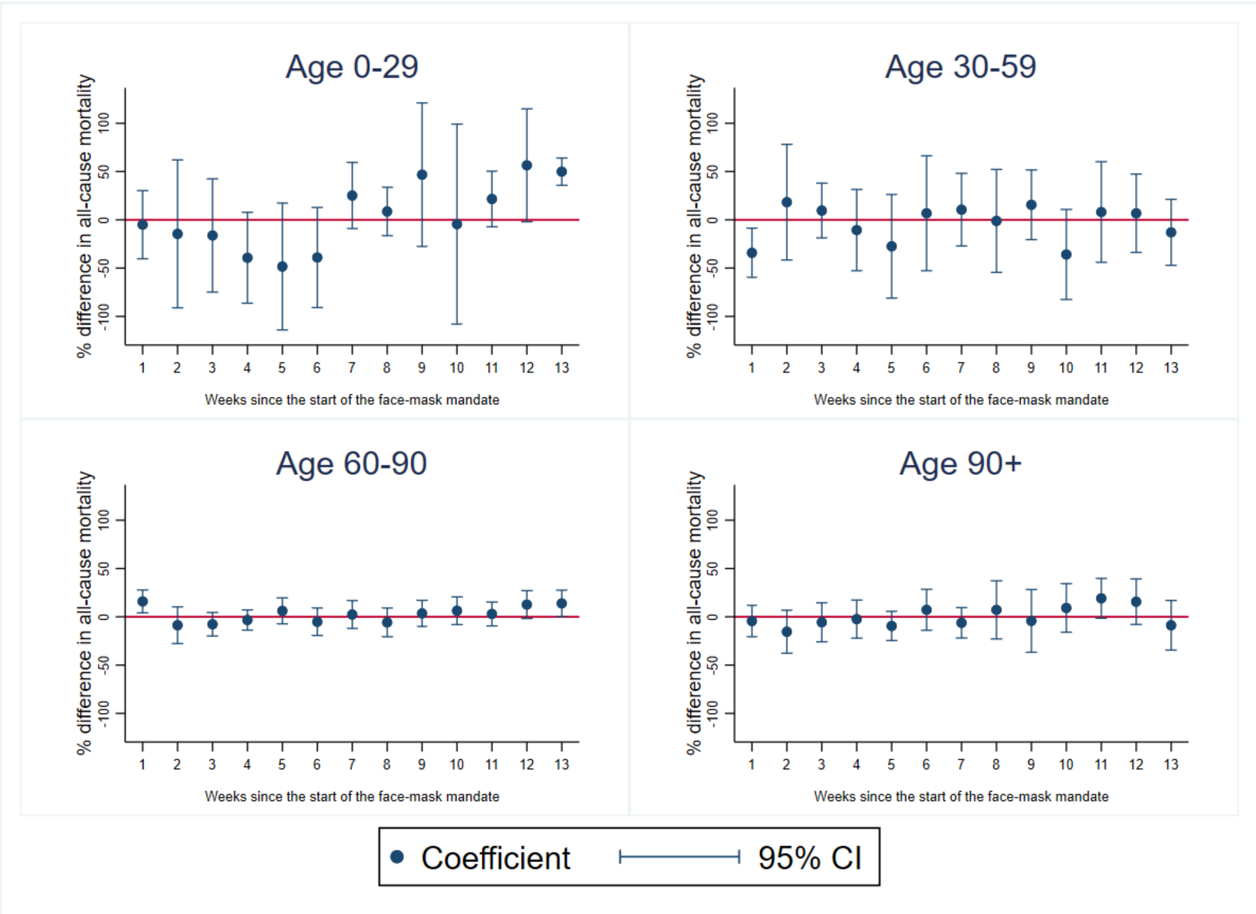

Figure 3. Effect of the face-mask mandate on all-cause mortality by age group using a Difference-in-Differences approach with dynamic beta-coefficients.

Note: Blue dots are the estimated β_2 in week w as in Equation (9), weighted using population as analytical weights. The percentage difference in all-cause mortality is approximated by the log. Week 1 is the first week after the treatment, until the 13th week. Outcome defined as Equation 2. Each vertical bar represents the respective 95% confidence interval.

Impact of Adding Contact Tracing and Social Distancing on All-Cause Mortality

When examining the effect of adding contact tracing and/or social distancing policies to the face-mask mandate, we found that the combination of face-mask mandates with social distancing rules appeared to be most effective (Table S16). Compared to implementing none of the policies (i.e., neither face-mask mandates, contact tracing, nor social distancing rules), this combination resulted in an estimated decrease in all-cause mortality of 5.1% (95% CI: -7.9% to -2.4%). While the point estimate of a 0.6% reduction in all-cause mortality (compared to implementing none of the three policies) for implementing all three measures (face-mask mandates, contact tracing, and social distancing policies) suggested a lower effectiveness of this combination compared with implementing face-mask mandates plus social distancing rules only, the difference between these policy "packages" was not statistically significant.

Impact on COVID-19 Cases and Deaths

We were unable to confidently establish the effect of the face-mask mandate on COVID-19 cases and deaths given the wide 95% CIs in Figure 4. However, while none of these effect estimates reached statistical significance, the pattern of the point estimates shown in Figure 4 suggests that the face-mask mandate may have decreased COVID-19 deaths in the initial two months after implementation, with the effect disappearing for longer time horizons. Text S3, Table S21-22, and Figure S14-S15 provide more details.

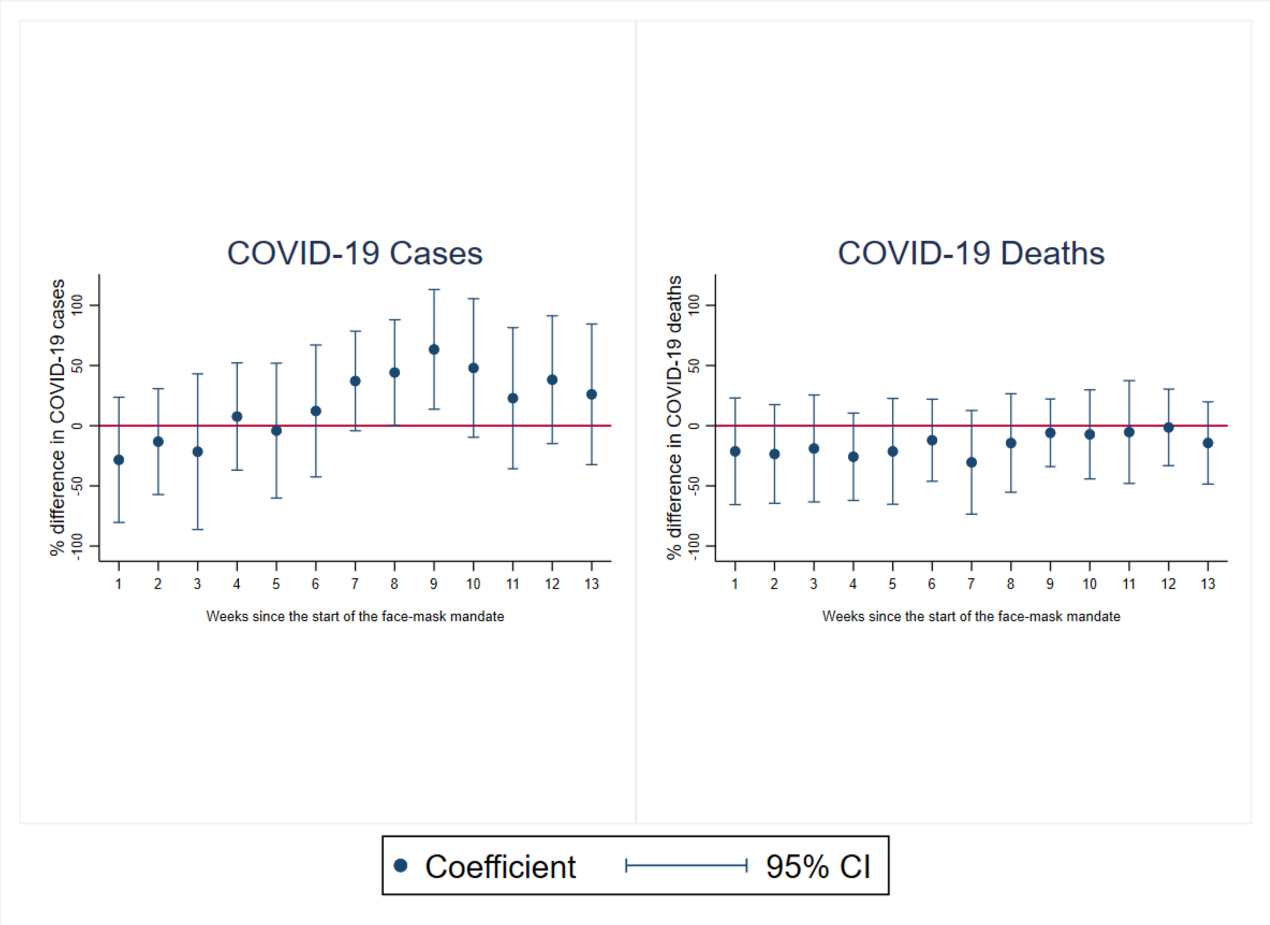

Figure 4. Effect of the face-mask mandate on COVID-19 cases and deaths over time.

Note: Blue dots are the estimated β_2 in week w; weighted using population as analytical weights. The percentage difference is approximated by the log. Week 1 is the first week after the treatment, until the 13^{th} week. Outcome defined as Equation S2 and S3, respectively. Each vertical bar represents the respective 95% confidence interval.

Discussion

Using a variety of quasi-experimental approaches, we took advantage of the unique policy environment in Switzerland to study the effect of mandating face-mask wearing in all indoor public spaces (in addition to mandating face masks on public transportation) in mid to late 2020 on all-cause mortality. We did not detect any significant impacts of this policy, neither on all-cause mortality, nor on COVID-19 cases and deaths. The statistical power of our analysis was sufficient to reject the possibility of large positive or negative effects of the face-mask mandates on all-cause mortality. The 95% CI for our primary analysis approach ranged from a relative change in all-cause mortality of -3.4% to 2.7%. We also did not find any evidence for substantial effect heterogeneity by sex, age, or time since implementation of the policy. There was some suggestion that the combination of face-mask mandates with social distancing rules is the most effective. However, with a reduction (compared to implementing none of the policy options) in all-cause mortality of 5.1% (95% CI: -7.9% to -2.4%), the estimated effect size was only moderate in size.

While some of our 95% CIs are wide and can thus not exclude the possibility of substantial effects of the face-mask mandate, in combination, all our analyses strongly suggest that the face-mask mandate did not have large effects on all-cause mortality. For instance, the lower bound for a beneficial effect of the face-mask mandate on all-cause mortality that is compatible with our 95% CI in our primary analysis approach is a 3.4% reduction in the weekly number of deaths in a canton. There are a number of possible reasons for which we did not find substantial mortality-reducing effects of the mandate. First, although the consistency of our estimates across analytical approaches increases our confidence in the findings, we cannot exclude the possibility of important confounding. Second, the population may have begun to adopt face-mask wearing prior to any official face-mask mandate. Third, the population may not have adhered to the mandate. Last but not least, the population may have adopted other measures (e.g., refraining from frequenting public indoor spaces) to reduce their risk of SARS-CoV-2 infection, such that there was no substantial additional benefit gained from face-mask wearing on top of the control cantons having already a mask mandate on public transport.

Although there likely is substantial variation by face-mask type (e.g., cloth masks versus surgical masks or N95 masks), there is strong evidence that face masks are effective in reducing symptomatic SARS-CoV-2 and other infections (Abaluck et al., 2021; Howard et al., 2020; Leung et al., 2020; Macintyre and Chughtai, 2015; Bundgaard er al., 2021; Leffler et al., 2020; Lyu and Wehby, 2020; Chernozhukov et al., 2021). However, the evidence on the impact of face-mask mandates is far weaker. In the United States, Chernozhukov et al., (2021) exploited variation in policy implementation during the early stages of the COVID-19 pandemic between states to estimate that face-mask mandates for employees in public businesses led to large reductions in COVID-19 deaths (Chernozhukov et al., 2021). Similarly, Lyu and Wehby (2020) adopted an event-study approach that found that state government face-mask mandates led to a reduction in new COVID-19 cases at the county level between March 31 and May 22, 2020. In Germany, both Mitze et al., and Kosfeld et al., (2021) took advantage of regional variation in the timing of face-mask mandates. Both estimated a substantial effect on reducing new COVID-19 cases. Finally, in Canada, taking advantage of variation in the start of face-mask mandates between public health regions in Ontario, Karaivanov et al., (2020) estimated that such mandates led to a reduction of COVID-19 cases by 25% during the first few weeks of implementation.

Our study is not only an important contribution to this emerging literature because of its focus on a new setting (Switzerland) but, most importantly, because it examines all-cause mortality as its primary outcome. Measuring COVID-19 cases and deaths has a number of difficulties, which are avoided by focussing on all-cause mortality. For instance, COVID-19 case identification is dependent on the extent to which a country conducts testing and the population's willingness to undergo or seek out tests (Omori et al., 2020). Similarly, reliably assigning the cause of death to COVID-19 can be difficult if diagnostic codes change over time or individuals die from a combination of proximal causes (Li, R. et al., 2020, Lipsitch, M. et al., 2015). In addition, focusing on COVID-19 deaths ignores indirect effects of face-mask mandates, such as deaths that are averted because the mandate improved the ability of the health system to care for patients without COVID-19 by preventing the health system from being overwhelmed with COVID-19 patients.

Our study has several additional strengths. First and foremost, our analysis is based on a set of reliable administrative data. We constructed a panel containing data on the weekly number of deaths in each Swiss canton between 2012-2020. We also collected data on total population between 2011-2019. Second, we used several different quasi-experimental techniques to assess the robustness of our findings. Third, we set the post-policy period from the date on which the face-mask mandate is introduced in the first canton (on July 7). This allows us to control for the possibility that the population in cantons without a face-mask mandate may anticipate that their canton will soon also adopt such a mandate, which in turn may affect people's behaviour (e.g., voluntary adoption of face-mask wearing prior to the policy coming into effect). Fourth, with long data series on deaths, we can control for canton and time fixed effects (week of the year for example) and thus allow for a flexible pre-trend in the outcome variables. This characteristic of our dataset also allows us to examine heterogeneity in the effect of the face-mask mandate over time. Lastly, the quasi-experimental setting in Switzerland allows us to not only study the effect of face-mask mandates but also the combination of face-mask mandates with contact tracing and social-distancing rules.

However, our study also has several limitations. First, we can only test for the additional effect of imposing compulsory mask wearing in public places beyond mandating face-mask wearing on public transportation. Second, the effects of face-mask mandates may be different in settings other than Switzerland for numerous reasons, including variation in the characteristics of the epidemic, the population, and the policy design and implementation. Third, the effects of face-mask mandates may be different at this current stage of the epidemic, such as because of differences in the circulating SARS-CoV-2 variants, the type of face mask that is worn, or because the population is more accustomed to face-mask wearing.

Our study found that mandating face-mask use in public indoor spaces (beyond requiring face-mask wearing on public transportation) in Switzerland in mid- to late 2020 did not result in substantial reductions in all-cause mortality. This analysis adds important evidence to the growing body of literature on which (and which combination of) non-pharmaceutical policy options are most effective at what stage of the pandemic and in which populations in preventing deaths from SARS-CoV-2 and similar viruses.

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Declaration of interests

The authors declare no competing interests.

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