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Descriptive Finding

Subnational variations in births and marriages during the COVID-19 pandemic in South Korea

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Contents

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Abstract

BACKGROUND
It has been postulated that the COVID-19 pandemic will contribute to fertility decline, especially in low-fertility contexts. Little is known how the consequences of the pandemic differed at the subnational level.

OBJECTIVE
We investigated whether fertility declined beyond the first wave in early 2020 at both the national and the subnational levels in South Korea. We also examined marital rates, given that delayed marriage is a strong driver of low fertility in many East Asian countries.

METHODS
Based on monthly birth and marriage registration data for the period from January 2016 to December 2021, we quantified monthly general fertility and marital rates before and after the pandemic across the 17 regions in Korea. We used paired t-tests and interrupted time-series analysis to compare before and after fertility or marital rates.

RESULTS
Our analysis suggests that, at least until 2021, fertility rates did not decline beyond the pattern explained by the already declining fertility in Korea. For marriages, we observed a clear post-pandemic decline across regions. Subnational variations in the impact of the pandemic were larger for fertility than for marriage.

CONCLUSIONS
Despite little evidence that the pandemic directly affected the number of births, the reduction in marriages is likely to have a significant impact on fertility in the coming years.

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CONTRIBUTION

We present among the first examination of subnational-level variations in the impact the COVID-19 pandemic had on fertility.

1. Introduction

The impact of the COVID-19 pandemic on fertility remains an open question; and it was, indeed, the theme chosen by the United Nations on World Population Day 2021. Due to the time lag between conception and parturition, the empirical evidence needed to answer this question has become available only recently. The earliest evidence based on data from high-income countries points to heterogeneous patterns across countries, with some countries reporting either negative or no visible changes in fertility as of late 2020 and early 2021 (Aassve et al. 2021; Ghaznavi et al. 2022; Gray, Evans, and Reimondos 2022).

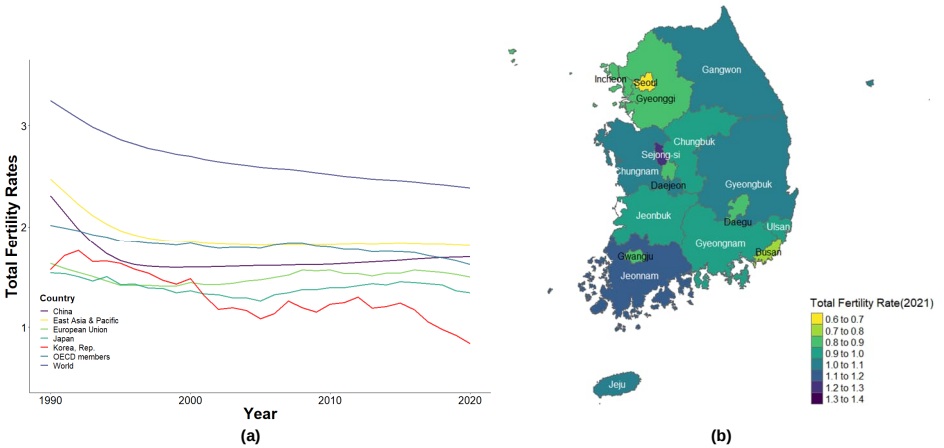
The present study examines the pandemic's impact on fertility in South Korea (hereafter Korea) beyond the first wave. Although the latest record-breaking low-fertility rate of Korea (Figure 1a) has been attributed to the COVID-19 pandemic (Hicks, Bouey, and Wang, 2022), an initial assessment at the transition of 2020 to 2021 finds little to no evidence in Korea (Aassve et al. 2021). The finding is at odds with the baby bust effect of the pandemic predicted for high-income countries (Aassve et al. 2020). It was anticipated that in these countries, like in Korea, the already low levels of work–life balance and high levels of economic uncertainty due to competitive labour markets would be exacerbated by the pandemic and would, in turn, depress fertility (Comolli and Vignoli 2021; Luppi, Arpino, and Rosina 2020).

Although Korea is regarded as a COVID-19 success story for having managed and controlled the outbreak without undergoing a macro-economic shock (Lim et al. 2021), the psychological burdens were particularly high and were disproportionately borne by women and young people in their twenties and thirties, whose rates of depression and suicide increased during the pandemic (Choi et al. 2021; Lee et al. 2021; Park, Kim, and Lee 2021). Given that these groups make up the core population engaged in childbearing decisions, it is still possible that fertility in Korea was negatively affected by the pandemic beyond the temporary impact of the first wave.

Regional variation in fertility is another reason to question the seemingly limited impact of the pandemic on fertility. In Korea, regional differences in fertility (Figure 1b) have been documented in relation to socioeconomic factors (Jung et al. 2019). The spread of the pandemic, the social-distancing measures imposed, and the economic shocks caused by the pandemic differed considerably across regions in Korea (Kang and Min 2021; Kim et al. 2021). During the first wave of the pandemic, Deagu and Gyeongbuk

were declared as special disaster regions and imposed with strong social-distancing measures. They also received financial and medical support from the central government. During the second wave, stronger social distance measures were applied to the capital area (Seoul, Incheon, and Gyeonggi region) and restricted daily routines other than vital social and economic activities. Thus, it is likely that the changes in fertility in response to the pandemic varied by regions, thereby masking the national-level impact.

Figure 1: Total fertility rates of (a) selected countries and supranational regions 1990–2020 and (b) 17 subnational regions in Korea in 2021



Source: The total fertility rate (TFR) data for selected countries come from the World Development Indicators (WDI), and the TFR data for the 17 regions of Korea come from the Korean Statistical Information Service (KOSIS).

When seeking to understand how the pandemic might affect future fertility in East Asian countries, it is important also to examine marriages. Delayed marriage is among the strongest drivers of very low fertility in Korea and in other East Asian countries, where childbearing within marriage still largely determines fertility trends and is reinforced by social norms (Fukuda 2020; Jones 2007; Raymo et al. 2015). A recent study on Japan found both birth and marriage deficits during the first year of the pandemic, but regional heterogeneity was not prominent (Ghaznavi et al. 2022). Unlike Japan, Korea did not declare a national-level state of emergency and had lower infection rates and infection-fatality ratios (Bollyky et al. 2022). As such, regional differences in the changes in fertility after the pandemic were more pronounced in Korea, revealing regional differences in previous fertility trends and in the pandemic's impact on livelihoods.

In this paper, we aimed to examine (1) fertility, (2) marital rates, and (3) regional heterogeneity therein, before and after the pandemic affected Korea. By examining both

fertility and marital rates at the regional level beyond the first wave, we seek to contribute to a better understanding of the regional heterogeneities within the longer-term impact of the COVID-19 on fertility.

2. Methods

2.1 Data

We obtained vital statistics on the numbers of live births and marriages from the monthly report released by Statistics Korea between January 2016 and December 2021. We then matched information on the monthly live births and marriages with information on the monthly resident register-based female population aged 15 to 49 years, within each 17 regions (8 provinces and 9 cities) that comprise Korea. At the national level, for each month, the female population of reproductive age was 12 million to 13 million, the number of births was 17,000 to 40,000, and the number of marriages was 14,000 to 28,000. The risk that the data were vulnerable to under-reporting was low because in Korea, registration of births (within one month of the birth) and registration of marriages (with no time requirement) are mandatory.

2.2 Analytic approach

Since the whole Korean population was exposed to the COVID-19 pandemic, we treated the population before the pandemic as a control group and during the pandemic as a case group. Monthly fertility and marital rates were calculated from January 2016 until December 2021 (72 months) with pre-pandemic data from January 2016 and January 2020 (49 months). The proportion of reproductive-aged women among the total female population in Korea decreased from 50% in 2016 to 45% in 2021. To partially control for the changes in the age structure, we used the monthly general fertility rates (GFRs; number of births per 1,000 women aged 15 to 49 years) and the monthly general marriage rates for females (GMRfs; number of marriages per 1,000 women aged 15 to 49 years), calculated as follows:

$$Monthly\ general\ fertility\ rates\ (GFRs) = \frac{Monthly\ live\ births \times (days\ of\ the\ year\ /\ days\ of\ the\ month)}{Monthly\ female\ population\ aged\ between\ 15\ and\ 49\ years} \times 1{,}000, \text{ and}$$

$$Monthly\ general\ marriage\ rates\ for\ females\ (GMRfs) = \frac{Monthly\ marriages \times (days\ of\ the\ year\ /\ days\ of\ the\ month)}{Monthly\ female\ population\ aged\ between\ 15\ and\ 49\ years} \times 1{,}000.$$

The disaster-impact period (Hamamatsu et al. 2014), when the impact of exposure (here, the pandemic) can be observed, was defined separately for births and marriages because births occur approximately 9 to 10 months after conception. For births, the disaster-impact period covered 13 months, from December 2020 (10 months after February 2020, when the first very large outbreak of cases in Korea occurred in Daegu; Kim et al. 2021) until December 2021 (10 months after February 2021, when the third and largest wave took place). For marriages, the disaster-impact period was 23 months, from immediately after the first outbreak began in February 2020 until December 2021.

We operationally defined February 2020 as the onset of the major shock we were interested in (i.e., the onset of exposure), but we also kept a year-long window of duration to reflect the extended period during which the pandemic had an impact. In early 2021, various pandemic-related mental health indicators reached their lowest levels in Korea (Kim and Lee 2021), which suggests that the impact of the pandemic continued and worsened over the course of the first year. Thus, the fertility and marriage rates measured in this study reflect the extended impact of the pandemic beyond the first wave.

We conducted two sets of statistical analyses. First, we used paired t-tests to compare the average monthly GFRs and GMRfs between time periods after having checked normality in monthly GFRs and GMRfs with the Shapiro–Wilk test. To take into account the seasonality of births in Korea, we compared the GFRs averaged over the disaster-impact period (labeled 'during-pandemic' here) with the GFRs of the months one year before (i.e., December 2018 and December 2019, or 'pre-pandemic I'). To further take into account the overall time trends of declining fertility in Korea, we compared the GFRs from the pre-pandemic I period with the GFRs of the 13 corresponding months between December 2016 and December 2017 ('pre-pandemic II'). If the COVID-19 pandemic had an impact beyond the declining trend in fertility, then only the comparison of during-pandemic versus pre-pandemic I should exhibit significant differences. A similar dual comparison approach was applied to compare the averages of the monthly GMRfs. Second, we conducted interrupted time-series analysis to flexibly model time trends in the GFRs and the GMRfs and to directly estimate differences in the GFRs and the GMRfs between the pre-pandemic and the post-pandemic periods. We specified a regression model employed in a previous study (Aassve et al. 2021):

$$GFR_t\ or\ GMRf_t = a_m + \beta COVID19_t + \sum_{i=1}^{3} \gamma Time_t^i + \epsilon_t \quad ,$$

where the dependent variables are GFR and GMRf in month-year t at the national and the regional levels, and a_m denotes fixed effects of month m. COVID19 is a dummy

variable (0, 1) which is equal to 1 when t is between December 2020 and December 2021 for births (13 months) and between February 2020 and December 2021 for marriages (23 months). $Time_t$ refers to the month and the year, and therefore γ^i are estimates of the linear, quadratic, and cubic time trends. Hence, the coefficients β estimate the average changes in the GFRs and the GMRfs between the pre-pandemic and during-pandemic periods after controlling for temporal trends and seasonality.

3. Results

In Korea, the changes in the fertility and the marital rates during the COVID-19 pandemic differed. First, for fertility, post-pandemic fertility did not differ much from the pre-pandemic level, which was already exhibiting a strong declining trend. Although the GFRs of the during-pandemic period were lower than those of the pre-pandemic I period, the GFRs of the pre-pandemic I period were also lower than those of the pre-pandemic II period in most regions (Table 1a), suggesting that the observed fertility decline during the pandemic was largely driven by the secular trends of fertility decline that has been ongoing in Korea. The results from the interrupted time-series analysis corroborated this observation. The time trends of the GFRs were similar in both the pre-pandemic and during-pandemic periods. In both periods, the monthly GFRs continued to decline steadily in most regions (Figure 2a). The S-shaped trends of GFRs in most regions during the pandemic period reflect the typical seasonal variation with a high number of births in January and September in Korea.

Second, there was clear evidence of changes in marital rates during the pandemic. The average monthly GMRfs did not differ between the pre-pandemic I and the pre-pandemic II periods, but the during-pandemic rates were lower than the pre-pandemic period (Table 1b). Interrupted time-series analysis confirmed that the time trends of the GMRfs changed during the pandemic (Figure 2b). While the monthly GMRfs during the pre-pandemic period remained relatively similar to the average of the monthly GMRfs for 2016–2019, the monthly GMRfs after the onset of the pandemic started declining in all regions. These results suggest that the COVID-19 outbreak had a negative impact on marriages in most regions.

Third, we observed larger regional heterogeneity in the impact of the pandemic on fertility. At the regional level, the coefficients of changes in GFRs after the beginning of the COVID-19 pandemic varied in both direction and magnitude between regions (Figure 3, red lines). Although the 95% confidence intervals overlapped with zero in most regions, we found that 9 out of the 17 regions had negative coefficients and the remaining eight had positive coefficients. In contrast, the coefficients of changes in regional-specific GMRfs after the beginning of the COVID-19 pandemic were all negative and varied only

in terms of magnitude (Figure 3, blue lines), which indicates that the impact of the pandemic on marriages was more consistent across regions than the impact on fertility.

Table 1: Comparison of the pre-pandemic and during-pandemic (a) general fertility rates (GFRs) and (b) general marriage rates for females (GMRfs) in the 17 regions of South Korea

(a) Changes in general fertility rates

	Pre-pandemic II	Pre-pandemic I	During-pandemic	Pre II–Pre I difference (*P*)	Pre I–During-pandemic difference (*P*)
National	**28.17**	**24.65**	**22.12**	**3.51 (<0.01)**	**2.53 (<0.01)**
Busan	26.31	22.15	19.78	4.16 (<0.01)	2.37 (<0.01)
Chungbuk	31.22	26.93	24.88	4.28 (<0.01)	2.05 (<0.01)
Chungnam	33.40	29.05	25.32	4.35 (<0.01)	3.74 (<0.01)
Daegu	26.34	23.11	19.77	3.22 (<0.01)	3.34 (<0.01)
Daejeon	27.95	22.94	21.29	5.01 (<0.01)	1.65 (<0.01)
Gangwon	27.15	26.08	24.76	1.07 (0.27)	1.32 (<0.19)
Gwangju	26.51	22.73	22.69	3.78 (<0.01)	0.04 (<0.97)
Gyeongbuk	31.69	27.34	24.35	4.35 (<0.01)	2.99 (<0.01)
Gyeonggi	28.44	25.33	23.46	3.11 (<0.01)	1.87 (<0.01)
Gyeongnam	30.67	25.99	22.60	4.67 (<0.01)	3.40 (<0.01)
Incheon	27.26	25.70	21.67	1.56 (0.14)	4.02 (<0.01)
Jeju	32.63	28.96	24.85	3.67 (<0.01)	4.11 (<0.01)
Jeonbuk	27.69	23.25	19.97	4.43 (<0.01)	2.26 (<0.01)
Jeonnam	32.11	29.92	21.00	2.20 (<0.01)	4.65 (<0.01)
Sejong	50.54	43.98	25.27	6.55 (<0.01)	6.69 (<0.01)
Seoul	24.83	21.12	37.29	3.72 (<0.01)	2.52 (<0.01)
Ulsan	32.34	27.63	18.60	4.71 (<0.01)	3.01 (<0.01)

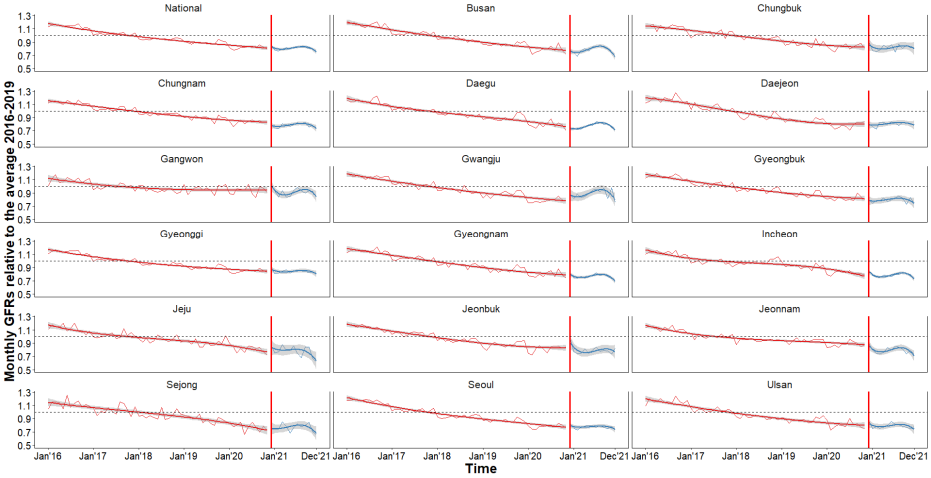
(b) Changes in general marriage rates for females

	Pre-pandemic II	Pre-pandemic I	During-pandemic	Pre II–Pre I difference (*P*)	Pre I–During-pandemic difference (*P*)
National	21.51	20.09	17.10	1.4 (0.08)	2.98 (<0.01)
Busan	19.91	18.28	15.79	1.63 (0.05)	2.49 (<0.01)
Chungbuk	22.47	21.46	18.89	1.01 (0.30)	2.57 (<0.01)
Chungnam	24.41	22.68	18.91	1.73 (0.09)	3.77 (<0.01)
Daegu	19.42	17.95	14.32	1.47 (0.09)	3.63 (<0.01)
Daejeon	20.52	18.83	16.23	1.69 (0.06)	2.59 (<0.01)
Gangwon	22.27	21.59	19.08	0.68 (0.48)	2.50 (0.01)
Gwangju	19.07	17.49	14.77	1.58 (0.04)	2.72 (<0.01)
Gyeongbuk	22.44	20.58	17.14	1.86 (0.05)	3.44 (<0.01)
Gyeonggi	20.73	19.65	17.34	1.07 (0.16)	2.31 (<0.01)
Gyeongnam	21.47	19.08	16.00	2.40 (0.02)	3.08 (<0.01)
Incheon	20.90	19.32	16.12	1.59 (0.03)	3.20 (<0.01)
Jeju	24.21	22.48	18.61	1.72 (0.15)	3.87 (<0.01)
Jeonbuk	19.58	18.26	15.61	1.33 (0.11)	2.65 (<0.01)
Jeonnam	21.54	20.51	18.44	1.03 (0.23)	2.08 (0.02)
Sejong	25.63	24.38	18.74	1.25 (0.38)	5.64 (<0.01)
Seoul	21.14	19.63	16.57	1.51 (0.06)	3.05 (<0.01)
Ulsan	22.79	20.46	17.25	2.34 (0.03)	3.20 (<0.01)

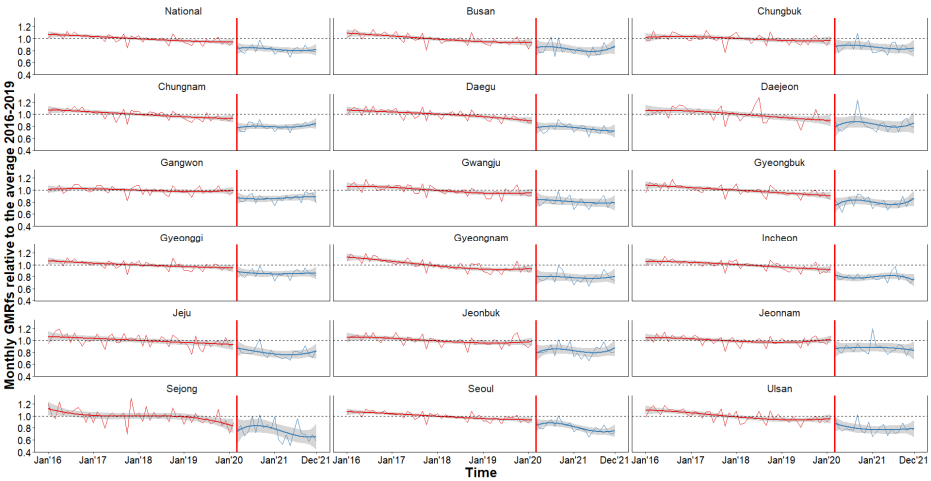
Notes: For GFRs, the during-pandemic period includes the GFRs of the 13 months from December 2020 to December 2021. The pre-pandemic I and II periods include the GFRs of the corresponding 13 months one year and two years before the pandemic, from December 2018 to December 2019 and from December 2016 to December 2017, respectively. For GMRfs, the during-pandemic period includes the GMRfs of the 23 months from February 2020 to December 2021. The pre-pandemic I and II periods include the GMRfs from February 2018 to December 2019 and from February 2016 to December 2017, respectively. *P* denotes p-values from two-sided t-tests.

Figure 2: Time trends of (a) the general fertility rates (GFRs) and (b) the general marriage rates for females (GMRfs), between the pre- (red) and during-pandemic (blue) periods, in the 17 regions of South Korea

(a) Monthly GFRs relative to the average 2016–2019

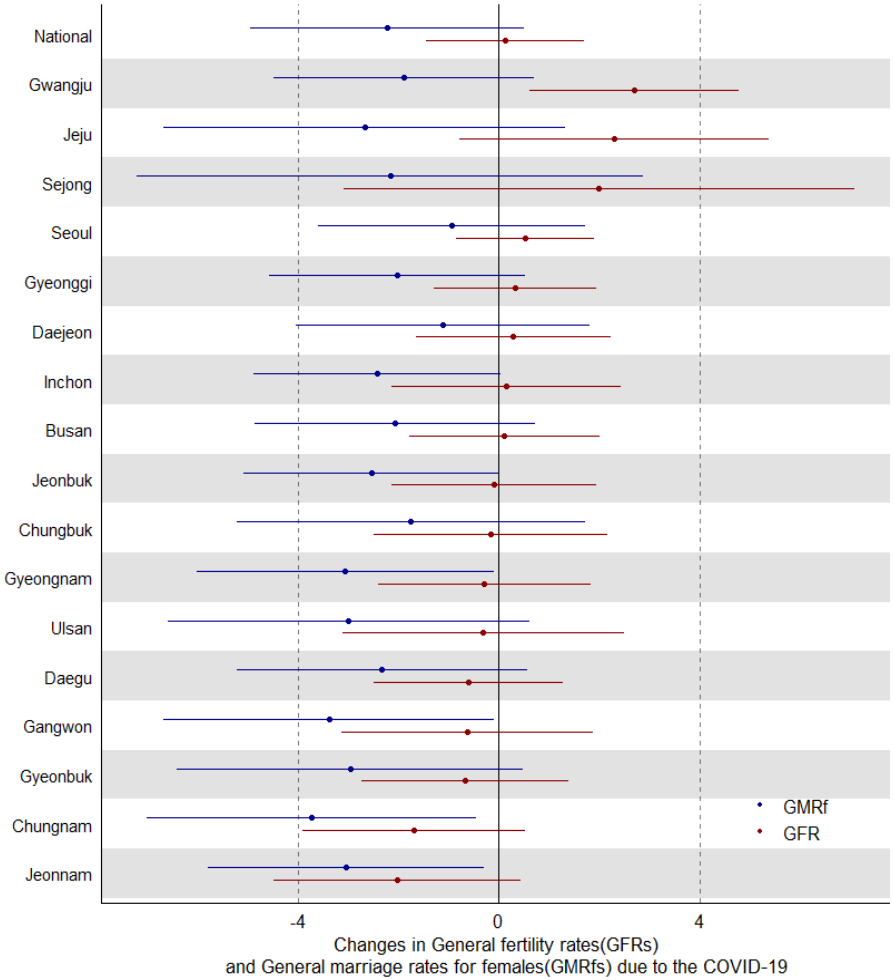


(b) Monthly GMRfs relative to the average 2016–2019



Notes: The time trends of (a) the GFRs and (b) the GMRfs were estimated through the interrupted time-series and were compared to the 2016–2019 average (dashed black lines) within each region. The shaded grey areas denote 95% confidence intervals. The red vertical lines refer to the COVID-19 pandemic cut-off for births (December 2020, i.e., 10 months from February 2020) and marriages (February 2020). Time trends are estimated based on the model $GFR_t \; or \; GMR_t = \beta COVID19_t + \sum_{i=1}^{3} \gamma Time_t^i + \epsilon_t$.

Figure 3: Changes in the general fertility rates (red) and the general marriage rates for females (blue) during the COVID-19 pandemic, in Korea at the national (top) and regional levels



Notes: Each point corresponds to the regression coefficient, and each line to its 95% confidence interval, for the effect of the pandemic in each region as estimated from the interrupted time-series analysis.

Of note, Gwangju was the only region where there was clear evidence of a slight increase in monthly GFRs after January 2021 (Figure 2a, Figure 3). This increase is

unlikely to be related to the COVID-19 pandemic, because, to our knowledge, Gwangju did not offer financial or public health care support in a form that differed greatly from COVID-19 related funds provided in other regions. However, Gwangju did sharply raise its pro-natalist cash grants for births starting in 2021. Given that Jeonnam, the province surrounding Gwangju, exhibited the largest decline in fertility (Figure 3, last row), and that these results together with those of our supplementary analysis (not shown) indicate that the degree of increase in Gwangju and the degree of decrease in Jeonnam largely match, it is likely that the observed increase in fertility in Gwangju occurred because women of reproductive age moved from Jeonnam to give birth in Gwangju rather than because fertility increased among the long-term residents of Gwangju.

4. Discussion and conclusions

Our analysis suggests that, at least until 2021, fertility rates did not differ from pre-pandemic levels beyond the pattern explained by the already declining fertility in Korea. In contrast, we observed an overall decline in marital rates after the pandemic across regions.

Previous studies suggested that economic losses and rising uncertainty due to the COVID-19 pandemic would depress fertility mainly via behavioural mechanisms, such as through adjustments of fertility intentions and preferences (Aassve et al. 2020; Voicu and Bădoi 2021). From this perspective, the seemingly little difference between pre- and post-pandemic fertility rates in Korea may be explained by the timely and effective financial and public health responses of the Korean government, which may have buffered the negative consequences of the pandemic. As yet, regional variation in the direction of post- versus pre-pandemic differences (Figure 3) suggests that the impact of the economic disruptions and the perceived uncertainty regarding the pandemic may have differed between regions. The amounts of Emergency Disaster Relief Funds largely depended on the fiscal capacity of provincial and local authorities to respond to the pandemic, resulting in substantial disparities in the amounts of financial support provided to households in different regions. Moreover, public health resources differed by region: city governments generally had abundant public health care resources and higher fiscal capacities for their pandemic response, while many local governments had health care resources below the national average and lower fiscal capacities (Park and Maher 2020). These regional contexts may explain why the post- versus pre-pandemic fertility difference was negative in Deagu and Gyeongbuk provinces, where the first wave of the pandemic occurred, while no such evidence of negative impact was observed in the most resourceful capital areas (Seoul, Gyeonggi, Incheon), where the second wave took place. Similarly, the post- versus pre-pandemic difference ranged above zero for most cities and

capital areas, whereas negative differences were observed for the most remaining regions (Figure 3).

Lower marital rates after the pandemic likely reflect many cancellations or postponements of weddings. The strict social-distancing measures implemented during the pandemic could not accommodate typical Korean weddings, in which the ceremony expenditures and the guest numbers tend to be very high. Another explanation is that voluntary reduction of mobility resulted in delaying the registration of marriages, although public offices remained open. If this is the case, we would expect marital rates to recuperate over time; but such a pattern was not noticeable at least until 2021. To confirm the impact of the pandemic on marital rates implied by our descriptive analysis, future works employing a stronger causal inference framework is needed.

Given the strong traditional link between marriage and childbearing in Korea, the decrease in the marital rate documented in the present study merits greater attention in terms of its impact on fertility – and especially in first births – in the coming years. Whether the fertility decline will result from the forgone marriages and whether such a consequence will later be reversed is unclear. For example, even if couples who delayed their wedding eventually marry, they may face challenges conceiving because they will now be older, and their fecundity (the physiological potential of reproduction) will decline. Moreover, challenges encountered during the pandemic may have altered intentions for marriage altogether (e.g., couples who delayed their marriage may give up on their family formation plans). This is because social-distancing measures continued until April 2022, and growing public health expenditures became considerable burdens in Korea due to social-distancing fatigue in the population and the country's current economic conditions, which are shaped by inflation and high interest rates. Analysis of age-specific marriage and fertility rates and parity-specific fertility will shed further light on how the pandemic affects tempo and quantum of fertility at the subnational level over the longer term.

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6. Data availability

Data on births and marriages are publicly available at https://kostat.go.kr/portal/eng/pressReleases/8/1/index.board and number of registered women of reproductive age at https://kosis.kr/eng/.

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