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ABSTRACT

Changes in Healthcare Utilization, Spending, and Perceived Health during COVID–19: A Longitudinal Study from Singapore*

The COVID–19 pandemic has challenged the capacity of healthcare systems around the world and can potentially compromise healthcare utilization and health outcomes among non-COVID–19 patients. Using monthly panel data of nationally representative middle-aged and older Singaporeans, we examined the associations of the pandemic with healthcare utilization, out-of-pocket medical costs, and perceived health. At its peak, doctor visits decreased by 30% and out-of-pocket medical spending decreased by 23%, mostly driven by reductions in inpatient and outpatient care. Although there were little changes in self-reported health and sleep quality, COVID–19 increased depressive symptoms by 4%. We argue that it is imperative to monitor COVID–19's long-term health effects among non-COVID–19 patients since our findings indicated delayed healthcare and worsened mental health during the outbreak.

JEL Classification: I12, I18

Keywords: COVID–19, pandemic, healthcare utilization, healthcare spending, self-reported health status, mental health

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Introduction

The novel coronavirus disease (COVID-19) has disrupted healthcare systems around the world. It is a direct health threat not only to patients who are infected, but also to those who are not via strained access to healthcare.[1] In the wake of the COVID-19 pandemic and in the absence of effective vaccines and treatments, governments have heavily relied on non-pharmaceutical interventions (NPIs), such as business and school closures, local and international travel bans, and stay-at-home and "shelter-in-place" orders, to contain the spread of the virus.[2, 3] Following Wuhan, China,[4] many Asian (e.g., Singapore,[5] India[6]) and European (e.g., Spain,[7] Italy[8]) countries adopted an intense nationwide lockdown policy. In the U.S., where most states issued "shelter-in-place" orders,[9] many patients delayed or cancelled necessary healthcare.[10] Due to fear of infection as well as resource-constrained healthcare delivery systems, healthcare utilization significantly dropped globally (e.g., by 38% in severe heart attack patients treated in nine major hospitals in the U.S.,[11] 64% in pediatric ER visits in Germany,[12] and 73% to 88% in pediatric ER visits in Italy).[13]

Reduced or delayed healthcare utilization during the pandemic can have detrimental health consequences. For instance, patients may suffer from delayed routine care, diagnoses, and

elective procedures, while halting clinical trials could have long-term negative effects on medical research.[14, 15] In particular, restrained healthcare services can affect older adults with chronic conditions more severely.[16-18] When older adults express fear and anxiety because of the pandemic,[19] they are encouraged to self-isolate for an extended period of time.[20] This could significantly generate serious long-term health consequences via decreases in healthcare utilization and spending, and worsened mental health status. Few studies have demonstrated how healthcare utilization, out-of-pocket medical spending, and health outcomes change during the COVID-19 pandemic,[21] primarily because of the lack of high-quality individual-level longitudinal data. We fill this gap in the literature by using individual-level monthly panel data from the Singapore Life Panel (SLP). The SLP collects rich information, such as healthcare utilization, healthcare spending, and health outcomes, from Singapore residents mainly aged 50 to 70.[5] We specifically examined the extent to which these outcomes of interest evolved before and during the pandemic in an international context in which an efficient national single-payer healthcare system along with a mandatory health savings account (called Medisave) is operated.[22]

Singapore is one of the countries that reported the first COVID-19 case in the early period of the pandemic (January 23,

2020).[23] By mid-April, the number of confirmed cases exploded due to contagion in high-density dormitories of low-wage migrant workers, which amounted to 43,661 cases as of June 30, 2020. Concerned with the spike in confirmed cases, the Singapore government imposed a set of nationwide partial lockdown policies, called the circuit breaker (CB), from April 7 to June 1. During the CB period, outside social gatherings were prohibited, and the use of face masks became mandatory. While "essential" services (e.g., urgent healthcare, transportation, groceries) were still allowed to operate, workers in "non-essential" services were required to work from home and all schools remained closed. Hence, Singapore's early COVID-19 experience, its lockdown policies, and the availability of unique individual-level panel data covering the period before and during the pandemic allow us to investigate 1) changes in healthcare utilization and expenditure, and 2) changes in perceived health status among middle-aged and older Singaporeans during the pandemic.

Study Data and Methods

Study Data

The SLP has surveyed nationally representative cohorts of Singapore residents mainly aged 50 to 70 since July 2015. It offers several advantages when studying the health impact of COVID-19. The SLP tracks monthly trends on healthcare

utilization, healthcare spending, and self-reported health status as well as other individual and household characteristics before and during the pandemic. Additionally, survey participation has not been interrupted by COVID-19 because the SLP is an internet-based survey. We used the data from the SLP from July 2018 through May 2020.

Outcomes of Interest

We measured healthcare utilization and healthcare spending as follows; the latter being the sum of out-of-pocket costs and anything paid from Medisave. First, we constructed a binary indicator of whether an individual saw a medical doctor each month. Second, we created a dummy variable by assigning "1" if a respondent has been told by a doctor that he or she has any health conditions, such as hypertension, diabetes, cancer, heart problems, stroke, arthritis, or psychiatric problems, and "0" if the respondent has not been diagnosed with any. Third, we constructed total healthcare spending by summing up six medical service categories: 1) inpatient care including hospital and nursing home care; 2) outpatient care including visits to doctors, traditional Chinese physicians, physiotherapists, and psychologists, eye care and dental service fees, and laboratory tests; 3) prescription drugs; 4) other drugs and medical products (e.g., Chinese medicine, wheelchairs); 5) health

insurance premiums; and 6) hiring home nursing services. All monetary units are expressed in 2019 Singapore dollars (S$).

We measured perceived health status through questions on self-reported health status, sleep quality, and depressive symptoms. First, respondents were asked to rate their health status on a 5-point scale of "excellent," "very good," "good," "fair," or "poor."[24] We constructed a dummy variable by assigning "1" if a respondent's self-reported health status is "good," "very good," or "excellent," and "0" if otherwise. Second, respondents were asked to rate their sleep quality: "Overall in the last 30 days, how much difficulty did you have sleeping, such as with falling asleep, waking up frequently during the night, or waking up too early in the morning?"[25] Respondents can answer with "none," "some," "moderate," "severe," or "extreme." A dummy variable was created by assigning "1" if a respondent's self-reported degree of sleep deprivation is "moderate," "severe," or "extreme," and "0" if otherwise. Lastly, respondents were asked about their depressive symptoms: "Overall in the last 30 days, how much of a problem did you have with feeling sad, low, or depressed?"[26] Respondents can answer with "none," "some," "moderate," "severe," or "extreme." We constructed a dummy variable by assigning "1" if a respondent's feeling sad, low, or depressed is either "some," "moderate," "severe," or "extreme," and "0" otherwise. Questions

on sleep quality and depressive symptoms were asked quarterly rather than monthly (January, April, July, and October).

Covariates

Since we used monthly individual-level panel data, we controlled for individuals' time-invariant characteristics by including individual fixed effects in the regression analysis. Additionally, we controlled for time-varying characteristics such as age, age squared, binary marital status (married or not), and the number of household members. To avoid the so-called "bad control" problem, we did not control for time-varying characteristics such as income and employment status, which can potentially be affected by COVID-19.[27]

Methods

We used a difference-in-differences (DID) method by comparing monthly changes to estimate the associations of the COVID-19 outbreak with individuals' healthcare use and spending, and perceived health status between the 2019 to 2020 season and the 2018 to 2019 season ("two seasons" hereafter). Specifically, we estimated equation (1):

$$y_{i,t} = \beta_0 + \beta_1 Season_t + \sum_{k \neq Jan} \beta_k 1[Mth_t = k] Season_t + Mth_t + \lambda_i + X'_{i,t}\gamma + \epsilon_{i,t} \quad (1)$$

where $y_{i,t}$ represents healthcare utilization, healthcare spending, and health status of individual i in month t. Mth_t are month dummies. January serves as the reference month because Singapore's first COVID-19 case was confirmed on January 23,

2020. $Season_t$ is a dummy variable whose value is "1" if the observed period is between July 2019 to May 2020, and "0" otherwise. λ_i denotes individual fixed effects. $X_{i,t}$ includes age, age squared, marital status, and household size. β_ks are the parameters of interest, which may capture associations between COVID-19 and dependent variables in each month compared to those in January. For statistical inference, we calculated standard errors clustered at the individual level to adjust for serial correlations of dependent variables within individuals. We reported 95% confidence intervals along with the DID estimates. Statistical analysis was conducted using STATA/SE 16 (StataCorp, College Station, Texas, USA).

Limitations

This analysis has limitations. First, we used self-reported survey data. Thus, the collected information on healthcare utilization, healthcare spending, and perceived health status could be subject to measurement errors. Second, the COVID-19 outbreak is still ongoing; thus, we cannot address its long-term impacts yet. Third, using monthly panel data and controlling for individual fixed effects and other confounders, there could be other plausible explanations for changes in healthcare utilization, healthcare spending, and perceived health status during the pandemic. Last, the current study surveyed middle-

aged and older adults. Hence, we should be cautious to apply the study findings to younger populations.

Results

Exhibit 1 describes the sociodemographic breakdown of the study population as of January 2020, the month before the COVID-19 outbreak in Singapore (N=7,569). The average age of study participants was 63.2 (standard deviation [SD]=6.4 years). There were more female (53%) than male (47%) participants. In terms of education, 23% graduated from the primary school level, 41% from secondary, and 36% from tertiary. Out of all respondents, 87% are ethnic Chinese and about 79% are married. On average, study participants had 2.9 children (SD=1.1) and 2.6 members (SD=1.4) in their households.

<EXHIBIT 1 GOES ABOUT HERE>

Exhibit 2 (Panel A) demonstrates that individuals were less likely to visit medical doctors during the outbreak. The trend lines (left) show that about 30% of survey participants met medical doctors between July 2018 and May 2019 each month; however, the share sharply decreased to around 20% to 25% during the pandemic. The DID estimates (right) confirm this pattern. The estimated share of respondents visiting doctors started to drop by 5.0 percentage points (pp) in March, and further decreased by 9.3 pp and 9.1 pp in April and May 2020, respectively. For instance, the 9.1 pp decline in May 2020

implies a 30% reduction in doctor visits compared to the average probability of doctor visits in January 2020 (=9.1/30.6). The estimates on the associations from March to May are statistically significant at the 5 percent level.

<EXHIBIT 2 GOES ABOUT HERE>

Exhibit 2 (Panel B) demonstrates that study participants were less likely to be diagnosed with a chronic condition during COVID-19. In the 2018 to 2019 season, the trend lines (left) show that the share of respondents diagnosed with chronic conditions decreased from about 15% between July and December 2019 to less than 12% in April and May 2020, while little change was observed during the 2018 to 2019 season. The DID estimates (right) confirm these findings. The estimated probability of being diagnosed with a chronic condition began to decrease by 2 pp in March 2020 and continued to decrease by 2.7 pp and 2.1 pp in April and May 2020, respectively. The estimates on the associations during March to May are statistically significant at the 5 percent level.

Exhibit 2 (Panel C) demonstrates that study participants were less likely to spend on medical care during COVID-19. The trend lines (left) indicate that total out-of-pocket medical expenditures have similar patterns between the two seasons until February 2020. However, it decreased from S$198 in January 2020 to S$182 in March, and further fell to S$165 in April, until it

rebounded to S$179 in May 2020. The DID estimates (right) confirm our findings. The estimated monthly healthcare expenditures started to decrease by S$19.9 in March 2020, and further decreased by S$46.5 in April and S$16.3 in May 2020. The S$46.5 reduction in May 2020 implies a 23% reduction in the total out-of-pocket spending compared to the average out-of-pocket spending in January 2020 (=S$46.5/S$198). The estimates on the association in April is statistically significant at the 5 percent level.

We further examined changes in out-of-pocket healthcare spending by type of medical services such as inpatient care, outpatient care, prescription drugs, other drugs and medical products, health insurance premium, and home nursing (Exhibit 3). This figure shows the DID estimates of the associations of COVID-19 by type of medical services in April 2020 using equation (1). It indicates that reductions in inpatient care and outpatient care account for 69% and 26%, respectively, of the total out-of-pocket healthcare spending reduction in April 2020 associated with COVID-19. These estimates are statistically significant at the 5 percent level.

<EXHIBIT 3 GOES ABOUT HERE>

Exhibit 4 displays the trend lines (left) and DID estimates (right) of self-reported health status (Panel A), sleep quality (Panel B), and depressive symptoms (Panel C) in the two seasons.

Panel A indicates little difference in trends of the proportion of respondents who reported having good, very good, or excellent health status between the two seasons. The DID estimates confirm that the differences are close to zero and statistically insignificant. Panel B presents little difference in the share of respondents who reported having moderate, severe, or extreme difficulty in sleeping between the two seasons. The corresponding DID estimates confirm that the differences are close to zero and statistically insignificant. Panel C demonstrates an increase in the share of respondents who reported feeling sad, low, or depressed from 71.0% in January to 72.5% in April 2020. The DID estimates show that the estimated share of respondents feeling sad, low, or depressed increased by 2.83 pp in April 2020, corresponding to a 4% increase compared to the January 2020 average (=2.83/71.0). The estimate for the depressive symptom in April is statistically significant at the 5 percent level.

<EXHIBIT 4 GOES ABOUT HERE>

Discussion

The COVID-19 pandemic has challenged healthcare systems worldwide. It is of great interest to policymakers and researchers to understand how healthcare utilization, healthcare spending, and perceived health status have evolved during the spread of COVID-19. Previous studies have only documented

snapshots of healthcare utilization[28, 29] and perceived health status[30-32] in the midst of the pandemic. To extend the literature, we provide comprehensive evidence on the changes in healthcare utilization, healthcare spending, and perceived health status during the COVID-19 pandemic using the individual-level panel data.

After the outbreak of COVID-19, middle-aged and older Singaporeans reduced their healthcare utilization by 23% in terms of total out-of-pocket healthcare spending. During the pandemic, there was a similar decrease in healthcare utilization in the U.S.: 32–40% in Emergency Department (ED) radiology volumes[33] and 49% in acute ischemic stroke patients.[34] Delaying healthcare is associated with longer hospital stays and poor health outcomes in the future.[35, 36] Strict non-pharmaceutical interventions such as stay-at-home orders have significantly reduced healthcare demand;[37, 38] however, individual risk avoidance behavior could be an important factor as well.[39] Similar to the Severe Acute Respiratory Syndrome (SARS) epidemic in 2013,[40] people's fear of the COVID-19 infection may have had strong impacts on healthcare utilization.[13, 41] However, it is difficult to disentangle the relative impact of NPIs and risk avoidance behavior on healthcare utilization because they are highly correlated. Further study is warranted to predict how

quickly medical utilization will rebound after the lockdown is lifted.

The reduced healthcare utilization can be related to both less out-of-pocket spending on healthcare services and fewer diagnoses of chronic conditions. Regarding out-of-pocket medical spending, few studies tracked changes in the spending during an epidemic,[42] especially by medical service type. The current study found that reduced healthcare spending during the pandemic was primarily driven by the decreased inpatient (69%) and outpatient care spending (26%), which is similar to the significant reductions in inpatient care (35%) and outpatient care (24%) observed during the peak of SARS.[40] Patients' spending reduction in inpatient care was expected when many elective surgical procedures were postponed subsequent to the WHO's declaration of COVID-19 as a pandemic and the United States Surgeon General's recommendation.[43, 44] Reduced spending in outpatient care was expected to occur when patients and physicians cancelled their non-essential visits due to the pandemic. In addition, reduced healthcare spending can be linked to the decreased number of diagnoses of chronic conditions (e.g., cancer, diabetes, stroke). We postulate that the reduced diagnoses may represent delayed diagnoses of chronic conditions, which proved deleterious to health outcomes.[45]

From a healthcare provider perspective, reduced out-of-pocket spending and disrupted healthcare systems can have considerable financial consequences.[46, 47] When the Singapore government implemented a nationwide partial lockdown policy from April 7 to June 1, 2020,[5] several complaints were reported from healthcare providers (especially dentists) fearing the loss of their patients and revenue.[48] In the U.S., hospitals and health systems reported financial losses amounting to $202.6 billion from March 1 to June 30 in 2020,[49] and it was estimated that primary care practices would lose US$67,774 in gross revenue per full-time physician in 2020.[50] Furthermore, the financial consequences are dire when it is difficult to forecast when patients can return to physicians' offices and hospitals (e.g., for non-emergent surgery or regular checkup) without fear of contracting the virus.[51] In addition, healthcare delivery systems will be further challenged when patients who delayed care during the pandemic ultimately make ED visits.[52, 53]

We found meaningful associations of COVID-19 with perceived health status. At least in the short run, self-reported health status as well as sleep quality did not change significantly during COVID-19. That may be because Singaporeans have maintained relatively good health before and during the pandemic, and have an efficient national single-payer healthcare system.[22] Singapore has a long life expectancy at birth (83.8

years in 2020)[54] as well as a low fatality rate from COVID-19 (0.06%), compared to the world average (4.80%) as of June 30, 2020.[55] However, we found that the virus is associated with an increase in depressive symptoms, which has been documented during the pandemic elsewhere as well.[56-58] The study findings imply that COVID-19 could affect multiple dimensions of perceived health differently in the short term. Further studies to track the long-term effect of the pandemic among non-COVID-19 patients are also warranted.

Conclusion

The current study provides a unique perspective related to changes in healthcare utilization, healthcare spending, and perceived health status among middle-aged and older adults during the pandemic. Our findings have the following implications. First, government-imposed NPIs should be carefully implemented to avoid interrupting "essential" healthcare services among non-COVID-19 patients. We need to adopt approaches that minimize adverse health consequences resulting from patients' delayed essential care. Second, as the pandemic is prolonged in the absence of effective vaccines and treatments, each government should continue monitoring the long-term health effects of non-COVID-19 patients, especially those who have existing health conditions and delayed healthcare visits. Third, the pandemic casts a grave challenge to

healthcare systems worldwide as the virus is still raging. To help non-COVID-19 patients, the medical community should prepare and promote tele-health practices at a large scale to prepare for the second wave of COVID-19. Lastly, patients should be "activated" to self-care for their chronic conditions, especially older adults with multiple chronic conditions.

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EXHIBIT 1 (Table)
Sociodemographic distribution of respondents to the survey before the COVID-19 outbreak in Singapore, January 2020 (N=7,569)

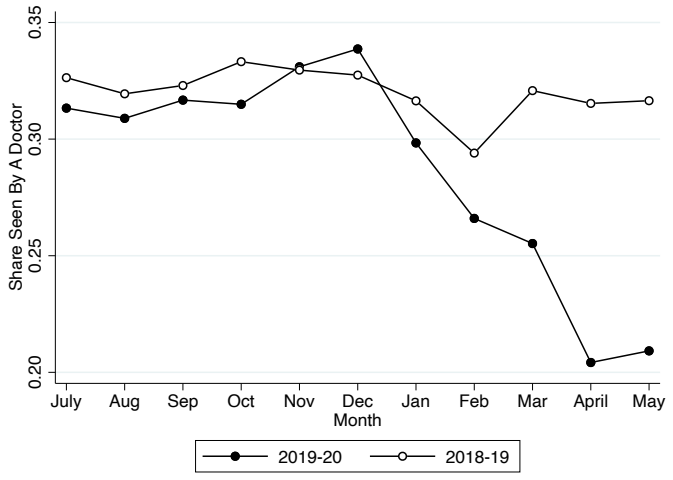
Variables	Mean (±SD) or N (%)
Age	63.2 (±6.4)
Sex	
Male	3,561 (47%)
Female	4,005 (53%)
Education	
Primary	1,721 (23%)
Secondary	3,143 (41%)
Tertiary	2,705 (36%)
Ethnicity	
Chinese	6,548 (87%)
Non-Chinese	1,021 (13%)
Marital status	
Married	5,962 (79%)
Unmarried	1,607 (21%)
Number of children	2.9 (±1.1)
Number of household members	2.6 (±1.4)

Source. Authors' analysis of data from the Singapore Life Panel Survey January 2020 Wave. **Note.** SD=Standard Deviation.

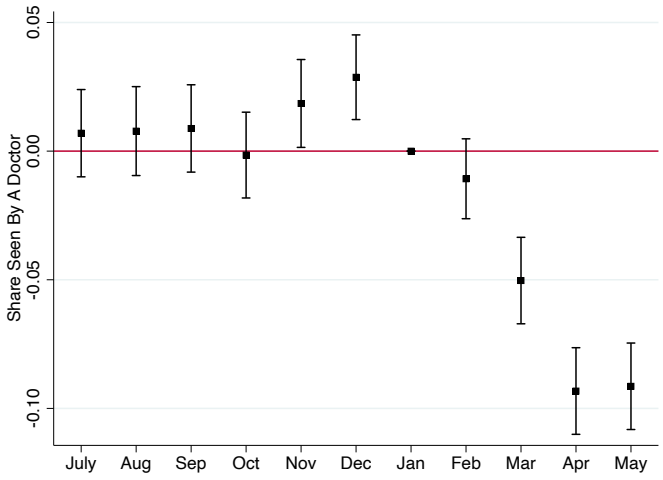
EXHIBIT 2 (Figure)
Changes in healthcare utilization, diagnosis of chronic conditions, and out-of-pocket medical spending before and during the COVID-19 outbreak in Singapore, 2018-2020

A. Changes in the share of respondents seen by a doctor between July and May

Trends

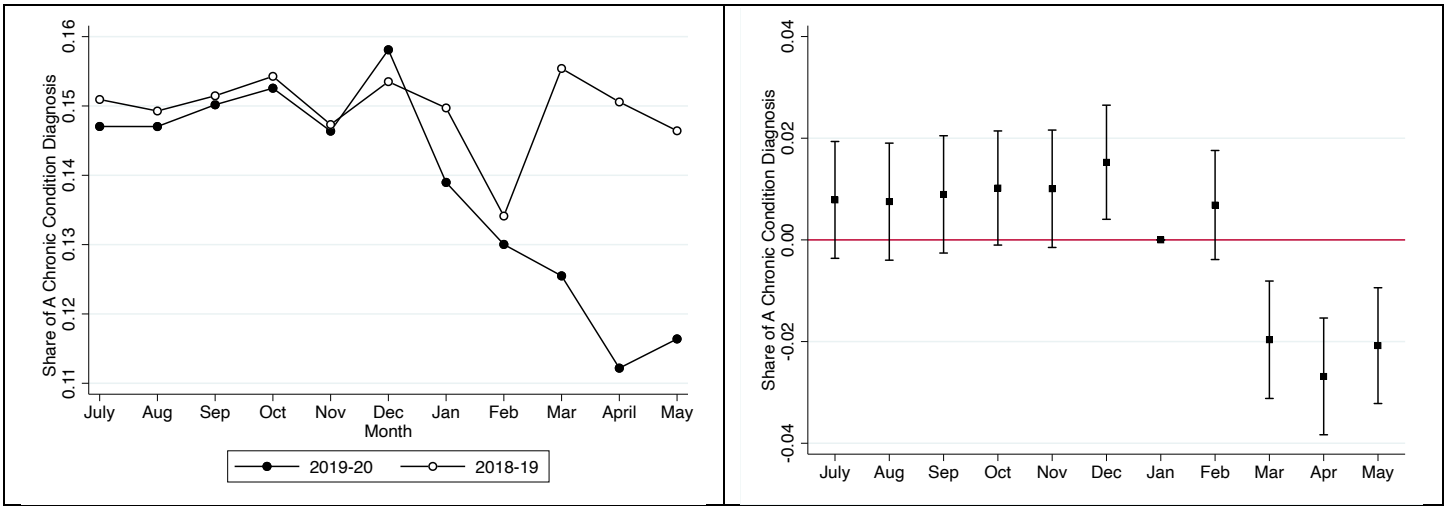


DID estimates



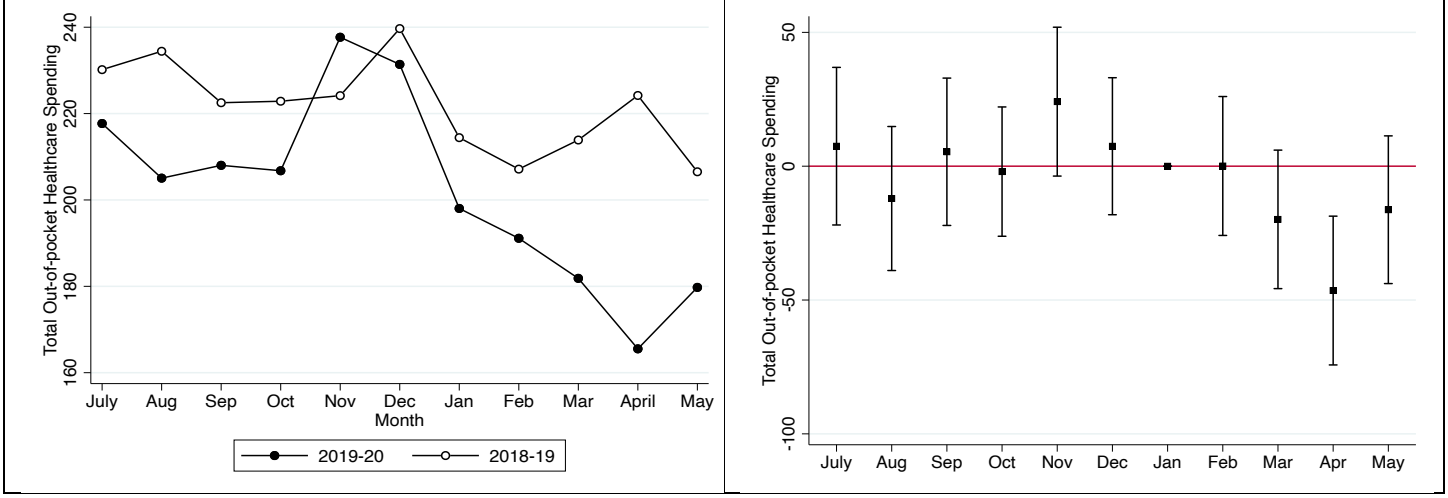
B. Changes in the share of respondents having a chronic condition diagnosed by a doctor between July and May

Trends	DID estimates



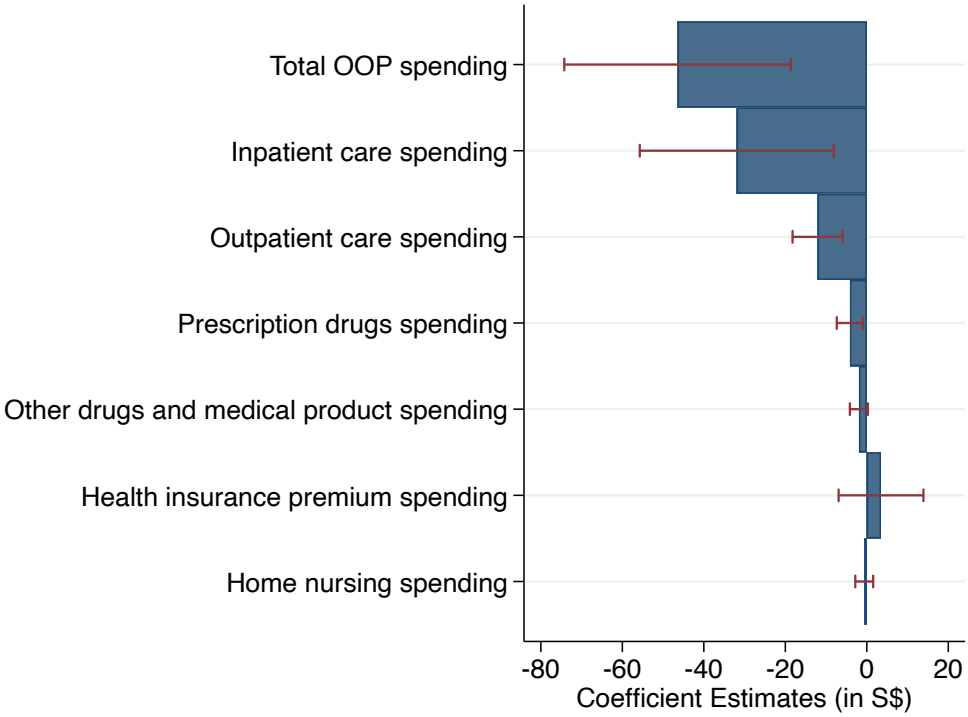
C. Changes in total out-of-pocket healthcare spending (in S$) between July and May

Trends	DID estimates



Source. Authors' analysis of data from the Singapore Life Panel Survey.
Notes. In the left columns, dots represent the average values of the outcome variable. In the right columns, square dots represent point estimates and caps indicate 95% confidence intervals. Standard errors are clustered at the individual level and corrected for heteroskedasticity. DID=difference-in-differences.

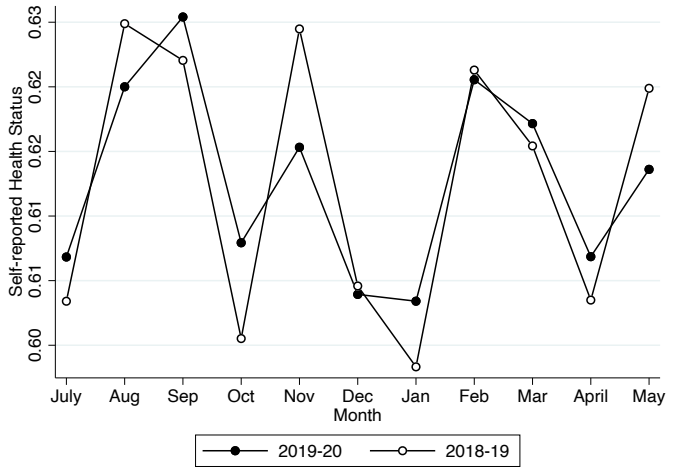
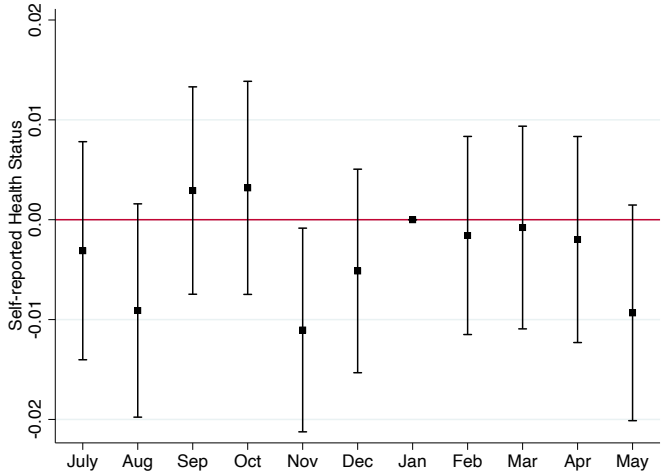
EXHIBIT 3 (Figure)
DID estimates in levels of medical care spending by type of medical service between January 2020 and April 2020



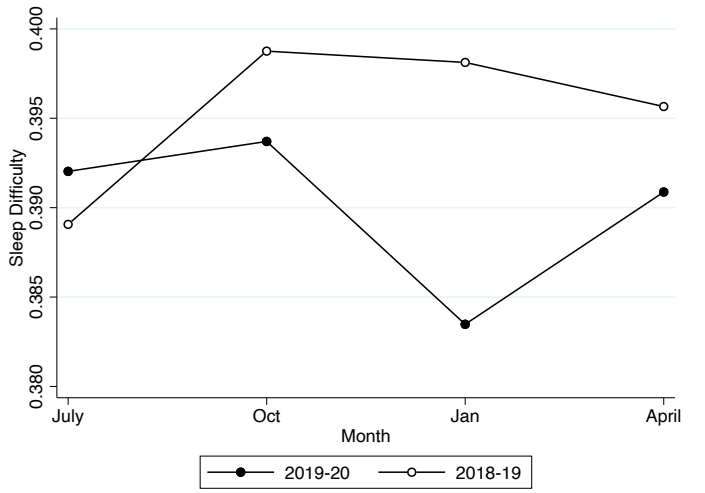
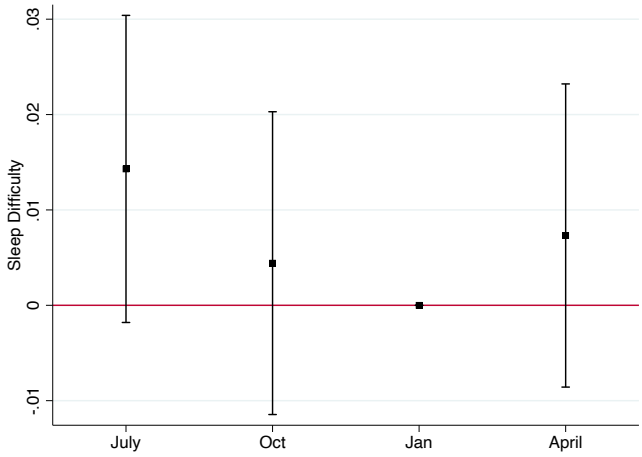
Source. Authors' analysis of data from the Singapore Life Panel Survey.
Notes. Caps indicate 95% confidence intervals. Standard errors are clustered at the individual level and corrected for heteroskedasticity. DID=difference-in-differences, OOP=out-of-pocket.

EXHIBIT 4 (Figure)
Changes in self-reported health status, sleep quality, and depressive symptoms before and during the COVID-19 outbreak in Singapore, 2018-2020

A. Changes in the share of respondents in good, very good, and excellent health between July and May

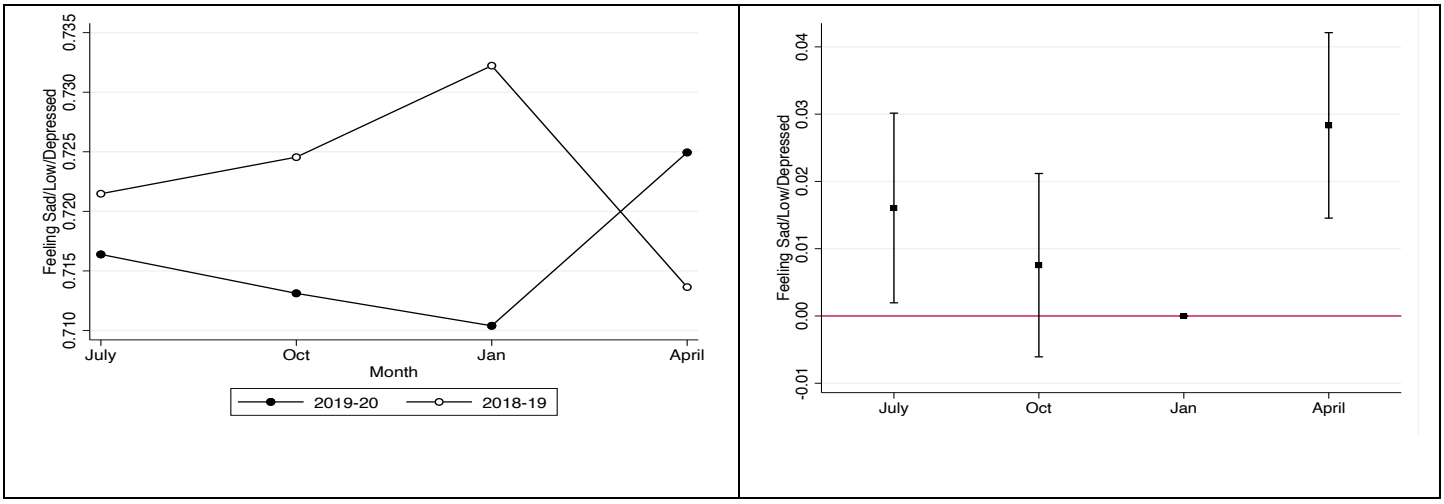
Trends	DID estimates
	

B. Changes in the share of respondents having moderate, severe, or extreme difficulty in sleeping between July and April

Trends	DID estimates
	

C. Changes in the share of respondents feeling sad, low, or depressed between July and April

Trends	DID estimates



Source. Authors' analysis of data from the Singapore Life Panel Survey.
Notes. In the left columns, dots represent the average values of the outcome variable. In the right columns, square dots represent point estimates and caps indicate 95% confidence intervals. Standard errors are clustered at the individual level and corrected for heteroskedasticity. Data of sleep quality and depressive symptoms are collected only quarterly. DID=difference-in-differences.