

DISCUSSION PAPER SERIES

IZA DP No. 13702

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## ABSTRACT

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# The Impact of COVID-19 on Subjective Well-Being: Evidence from Singapore\*

We provide novel evidence on how the COVID-19 global health and economic crisis is affecting overall life satisfaction and domain-specific satisfaction using data from a monthly longitudinal survey of middle-aged and older Singaporeans. Using a difference-in-differences framework, we document large declines in overall life satisfaction and domain-specific satisfaction during the COVID-19 outbreak, except satisfaction with health. These declines coincide with the introduction of a nationwide lockdown, with life satisfaction remaining below its pre-pandemic levels even after the lockdown is lifted. We also find that individuals who report a drop in household income during the COVID-19 outbreak experience a decline in overall life satisfaction almost twice as large as those who do not report any income loss.

**JEL Classification:** E2, I12, I31

**Keywords:** COVID-19, pandemic, life satisfaction, subjective well-being, individual-level monthly panel data, difference-in-differences

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## 1. Introduction

The COVID-19 pandemic has had a profound impact on human lives, claiming almost 900,000 deaths worldwide. In the absence of a vaccine for the virus, many governments have implemented social distancing rules in attempts to curb the spread of the virus. These interventions, which include national lockdowns, closure of non-essential workplaces and schools, and limiting of daily movement and social gatherings, have disrupted day-to-day lives and activities.

Although these measures are targeted primarily at minimizing mortality rates (Flaxman et al., 2020; Hsiang et al., 2020), many policymakers and researchers are concerned about other potential costs. Specifically, economic consequences have been dire, with the collapse of economic activity pushing many economies to the brink of recession. A number of studies have documented significant declines in spending and labor market outcomes measured by employment and wages (Andersen et al., 2020; Baker et al., 2020; Béland et al., 2020; Carvalho et al., 2020; Chen et al., 2020; Coibion et al., 2020; Forsythe et al., 2020; Kim et al., 2020; Surico et al., 2020). In addition to economic costs, these social distancing measures can have significant, negative impacts on well-being and mental health by increasing anxiety, depression, stress, and other negative emotions (Brooks et al., 2020; Holmes et al., 2020). As such, there are increasing calls to consider the impact of COVID-19 on people's psychological well-being and mental health.

Given that COVID-19 has affected our lives largely through trauma and isolation as well as economic loss, these are plausible influences underlying the well-being effects of COVID-19. One strand of literature has focused on the well-being effects of trauma and isolation, namely, through large-scale human and natural disasters. For example, Galea et al. (2002), Neria et al. (2007), and Clark et al. (2020) document that the September 11 World Trade Center terrorist attacks, Hurricane Ike, and the 2013 Boston marathon bombing, respectively, increased the incidence of depression, post-traumatic stress disorders, and a broad range of mental and behavioral disorders, and reduced subjective well-being. Hawryluck et al. (2004) and Liu et al. (2012) show that the severe acute respiratory syndrome in 2003 resulted in poorer mental health among individuals subjected to quarantine, with effects persisting up to three years onward. However, these studies investigating the effects of traumatic events can only provide partial insights into the consequences on well-being of the current pandemic. Another strand of literature has examined the impact of recessions and business cycles on well-being. Extensive research has shown that economic downturns are harmful for health (Ruhm,

2000, 2015; Janke et al., 2020), mental health (Engelberg & Parsons, 2013; Avdic et al., 2020), and life satisfaction (Di Tella et al., 2003; Luechinger et al., 2010). However, these economic shocks have not been accompanied by a global health crisis and social isolation and, thus, it is likely that the well-being impact of COVID-19 would differ from that of recessions.

As such, analyzing the well-being effects of COVID-19 is complex. Unsurprisingly, rapidly emerging international literature suggests that the relationship between COVID-19 and lockdown measures and well-being is not straightforward. Studies find that the pandemic has had negative effects on mental health in the UK, Japan, and New Zealand, and has resulted in a high frequency of internet searches for terms associated with mental health in Europe and the US (Banks & Xu, 2020; Brodeur et al., 2020; Sibley et al., 2020; Yamamura & Tsutsui, 2020). Other studies find that while well-being and mental health dipped following the initial spread of the pandemic, the implementation of lockdowns has resulted in improvements in these. For example, Foa et al. (2020) document a worsening of mood states (e.g., experience of happiness, sadness, loneliness) and life satisfaction following the COVID-19 outbreak in the UK, with both these well-being measures returning close to their pre-pandemic baseline levels a month after the lockdown. These findings are consistent with evidence from Switzerland and France (Brülhart & Lalive, 2020; Recchi et al., 2020).

In this paper, we provide novel evidence of how COVID-19 affects overall life satisfaction and domain-specific satisfaction using data from the Singapore Life Panel (SLP), which is a monthly panel survey of middle-aged and older Singaporeans. The SLP offers a number of advantages over existing data collections when studying the well-being impact of COVID-19. First, the SLP has information on life satisfaction measures collected on a monthly basis prior to and during the pandemic. This is critical for assessing how individuals' life satisfaction has evolved over the pandemic timeframe. There are a number of new longitudinal studies collecting information on mental health and well-being (e.g., COVID-19 Social Study by researchers at University College London), but these began only after the pandemic started.<sup>1</sup> Existing cohort studies, such as the Understanding Society in the United Kingdom and the German Socio-Economic Panel, have added new questions to collect information relating to COVID-19, although data immediately prior to the pandemic outbreak are not often available due to the infrequent nature of the survey collection. Second, because the SLP is an internet-based survey, participation has not been interrupted by the pandemic as with the experience of

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<sup>1</sup> A catalog of longitudinal studies on mental health and well-being is maintained by the COVID-MINDS Network (2020).

face-to-face surveys. Last, the detailed information on the characteristics of individuals and households allows us to examine heterogeneity in the impact of the pandemic along a number of dimensions.

Using a difference-in-differences (DID) specification, we document a large decline in overall life satisfaction during the COVID-19 outbreak in Singapore. This decline coincides with the introduction of a nationwide lockdown in April and May 2020. Even after the lockdown is lifted in early June, overall life satisfaction recovers to some extent but still remains lower than its pre-pandemic level. Domain-specific satisfaction with social relationships, daily activities, jobs, economic situations, and household income show similar patterns. By contrast, satisfaction with health is unaffected throughout the pandemic, despite the mortality and morbidity risks associated with COVID-19. We find some evidence of heterogeneous effects, with effects differing by household wealth and health literacy, but not by age, gender, presence of chronic conditions, and risk tolerance. Finally, individuals who have lost household income during the COVID-19 outbreak experience a decline in overall life satisfaction almost twice as large as those who do not report any income loss.

The remainder of the paper is structured as follows: Section 2 provides an overview of the COVID-19 situation in Singapore. Section 3 presents our data and Section 4 discusses our empirical strategy. Section 5 discusses the results and we conclude in Section 6.

## 2. Background on COVID-19 in Singapore

As of September 6, 2020, Singapore recorded 57,022 COVID-19 positive cases. Figure A1 Panels A and B show the trends of confirmed COVID-19 cases and deaths, respectively. The first COVID-19 case in Singapore was confirmed on January 23, 2020. After confirming a few more cases, the government implemented border restrictions, meticulous contact tracing, and self-quarantine procedures. Despite the government's extensive efforts, the number of confirmed cases exploded in April 2020 due to undetected contagion in the high-density dormitories of low-wage migrant workers. As a result, the Singapore government imposed a set of nationwide partial lockdown policies, called the circuit breaker (CB), from April 7 to June 1, 2020. During the CB period, citizens were not allowed to have social gatherings and workers in services deemed non-essential by the government were required to work from home. Schools were also closed. Only services considered essential, such as healthcare (excluding non-urgent care), transportation, restaurants (delivery and take-away orders), and groceries, could operate during this period.

A unique aspect of the COVID-19 pandemic in Singapore is the country's persistently low mortality rate. The COVID-19 case-fatality rate has been about 0.05% (27 deaths), much lower than the worldwide mortality rate of about 3.8% (World Health Organization, 2020). This is likely because most confirmed cases in Singapore have been among migrant workers from developing countries, who are mostly young and healthy.

### 3. Data

The SLP is a nationally representative monthly longitudinal survey of Singapore residents mainly aged 50–70 years at the time of the survey's commencement in July 2015 (now aged 55–75). We use the survey data from July 2018 through July 2020. Since the severity of the pandemic has quickly evolved in the past few months along with the CB, the high-frequency nature of the data enables us to investigate how the pandemic and lockdown measures relate to changes in individuals' life satisfaction. The outcome variables we study are overall life satisfaction and domain satisfaction. Overall life satisfaction is measured through the following question: "Taking all things together, how satisfied are you with your life as a whole these days?" Respondents rate their overall life satisfaction on a five-point scale from "very dissatisfied," "satisfied," "neither satisfied nor dissatisfied," "satisfied," and "very satisfied." We treat this as a cardinal variable, assigning a value of one to "very dissatisfied" and five to "very satisfied." Domain-specific life satisfaction questions include satisfaction with social relationships, overall economic situation, and health. These aspects are measured via the question "How satisfied are you with your i) social contacts and family life, ii) overall economic situation, iii) daily activities and job (if working), iv) total household income, and v) health?" As with overall life satisfaction, respondents provide their responses to domain satisfaction on a five-point scale.

To account for the ordinal nature of life satisfaction variables, as a robustness check, we use a heteroskedastic ordered probit method, following Chen et al. (2019). In addition, we use a binary indicator variable for whether a respondent's response to the life satisfaction question is "satisfied" or "very satisfied."

We control for individuals' time-invariant characteristics by including individual-fixed effects in the regression analysis. Additionally, we control time-varying characteristics such as age, age squared, marital status (married or not), and the number of household members. However, we do not include other time-varying characteristics, such as income and employment status, because these variables can potentially be affected by COVID-19. Table 1

presents the summary statistics of our study sample as of January 2020. On average, our sample respondents are 63.2 years old; 41% and 35% have completed secondary and tertiary education, respectively; 87% are ethnic Chinese; and 79% are married. The average number of children is 2.93; and the average household size is 2.56.

#### 4. Empirical Strategy

To identify the impact of the COVID-19 outbreak on life satisfaction, we compare changes in life satisfaction measures between the 2018/2019 season and the 2019/2020 season (hereafter, two seasons). We use January 2020 as the reference month, as Singapore's first case was confirmed on January 23, 2020. To implement this research design, we estimate the following DID specification:

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

where  $y_{i,t}$  represents the self-reported measure of life satisfaction of individual  $i$  in month  $t$ .  $Season_t$  is a dummy variable indicating if the observed period is the 2019/2020 season.  $\lambda_i$  denotes individual fixed effects.  $\omega_t$  are month dummies.  $X_{i,t}$  includes the above-mentioned control variables.  $\beta_k$ s are the parameters of interest, which capture the impact of COVID-19 on life satisfaction in each month evaluated against January parameters. For statistical inference, we calculate standard errors clustered at the individual level.

The key identification assumption of the DID specification is that the trends of outcome variables are parallel between the two seasons in the absence of the COVID-19 pandemic. To indirectly test this assumption, we examine if the parameters  $\beta_k$ s, where  $k$  refers to the months from August to December, are close to zero in magnitude and statistically insignificant.

#### 5. Results

##### 5.1 Effects of COVID-19 on Subjective Well-Being

Figure 1 presents the trends in overall life satisfaction in the two seasons. The mean overall life satisfaction score falls sharply from March 2020 onwards compared with levels in the preceding months. April and May 2020 show the lowest scores, following the implementation of the nationwide lockdown on April 6. Once the eight-week lockdown is lifted on June 2, life



satisfaction levels begin to rebound in the months of June and July 2020. The dynamic patterns in 2020 starkly contrast with the overall life satisfaction trends one year prior to the COVID-19 outbreak, represented by the dashed line in Figure 1. We observe similar patterns to Figure 1 when using a binary indicator that self-reported overall life satisfaction is either satisfied or very satisfied as an alternative dependent variable (see Figure A2).

In Figure 2, we present the DID estimates of the effects of COVID-19 on overall life satisfaction and domain-specific satisfaction measures using equation (1). In Panels A to F, each dot shows the estimated change in these life satisfaction measures between the two seasons evaluated against the difference in January with 95% confidence intervals. Consistent with the findings shown in Figure 1, the estimates in Panel A indicate that COVID-19 has resulted in a significant drop in overall life satisfaction levels. Mean overall life satisfaction scores first fell by 0.04 points in March, followed by sharp drops of 0.13 points in April and 0.14 points in May. The magnitude of the drops in April and May correspond to 0.17 and 0.18, respectively, of the standard deviation (SD) of the life satisfaction score observed in January 2020. Following the end of the lockdown, life satisfaction increases slightly in June and July, but remains 0.08 to 0.10 points lower compared with January 2020. The corresponding regression results are reported in Table 2 and all estimates are statistically significant at the 5% level.

In Panels B to F, we present the estimated effects of COVID-19 on domain-specific life satisfaction. We show the domains of i) social contacts and family life, ii) overall economic situation, iii) daily activities and job (if working), iv) total household income, and v) health, as dependent variables in Panels B to F, respectively. Most domain-specific life satisfaction measures show similar patterns compared with overall life satisfaction. For example, satisfaction with social contacts and with daily activities both drop by approximately 0.17 points, with the magnitude of the drops corresponding to 0.23 and 0.22 of the SD of their respective scores in January 2020. Compared with the other domains, satisfaction with household income appears the least affected, dropping by 0.09 points in May 2020 (0.11 SD).

Although the COVID-19 pandemic has resulted in widespread mortality and morbidity, we find little evidence that the pandemic decreased life satisfaction with health (Panel F, Figure 2). This result is consistent with the effect on self-reported health status as shown in Figure A4, originally reported by Ahn et al. (2020) and reflected in the low COVID-19 fatality rate (0.05%) in Singapore. A plausible explanation is that the rate of community transmission is low as the majority of cases are among migrant workers confined to dormitories. Hence, the

perceived health risk among those who have not been infected might also be low. Taken together, our results indicate that changes in overall life satisfaction are likely due to changes in social activities and economic situations.

To account for the ordinal nature of the original life satisfaction variable, we re-estimate equation (1) using the heteroskedastic ordered probit model following the recommendation of Chen et al. (2020). These regression results reported in Table A1 are similar to those in Table 2, implying that the baseline results are robust to an alternative estimation method.

## 5.2 Heterogeneous Effects

In addition, we investigate if COVID-19 negatively affects the well-being of specific sub-groups in our sample. The results showing the heterogeneous effects of COVID-19 on overall life satisfaction are reported in Figure 3, with the regression results reported in Table A3.

First, past studies have shown that economic recessions are more likely to affect those of a lower socioeconomic status (SES) more severely as these individuals experience larger income shocks (Hoynes et al., 2012). During the current recession, individuals with low SES are experiencing larger reductions in labor income (Kim et al., 2020). Hence, we examine the differential impact of COVID-19 by the average total household net worth from January 2018 to January 2020 to assess if economic resources act as a buffer to cushion the adverse impact of the pandemic on individuals' well-being. Panel A, however, shows that the reductions in overall life satisfaction are greater among those with higher net worth. We also find similar results using other SES measures, such as household income and education levels, while finding no evidence of heterogeneity by demographic characteristics such as gender. The larger observed drop in life satisfaction among individuals with a higher level of wealth may be due to differential rates of changes in consumption spending. Kim et al. (2020), for example, found that consumption spending decreased by a larger magnitude among richer households compared with poorer households during the COVID-19 outbreak in Singapore.

Second, individuals with underlying health conditions are known to be especially vulnerable to the virus. To examine the role of this potential risk, we assess if COVID-19 negatively affects the well-being of individuals in poorer health more than healthier individuals. As a measure of individuals' pre-pandemic health conditions, we construct a dummy variable indicating whether a person has any chronic health conditions (diabetes, heart problems, arthritis, hypertension, psychiatric problems, cancer, or stroke) between January 2018 and January 2020. Panel B provides no evidence, suggesting that individuals with chronic

health conditions suffer a larger drop in well-being.<sup>2</sup> The results remain similar when using age as an alternative proxy for the underlying health condition. We find little evidence of heterogeneity by age groups (relatively younger individuals versus relatively older individuals).

Risk preferences are central to economic and health choices and have been found to affect risky health behaviors (Anderson & Mellor, 2008). Individuals' level of health literacy also significantly influences healthcare choices as these decisions involve processing complex information on expected benefits and costs of health intervention (Maurer, 2009). We hypothesize that the manner in which individuals perceive the health risk of COVID-19 can heterogeneously affect their subjective well-being. To examine the role of individuals' perceptions, we posit that the heterogeneous effects of COVID-19 on well-being vary by risk tolerance and health literacy. Our hypothesis is that individuals with higher risk tolerance might consider the health risk of COVID-19 to be smaller than those with lower risk tolerance. As a measure of risk tolerance, we use a self-reported level of risk tolerance from 0 to 10. Panel C shows that there is no evidence suggesting that COVID-19 has a different effect on individuals who are more willing to take risk than those who are less willing. However, Panel D demonstrates that individuals who are more health literate suffer a larger drop in overall life satisfaction.<sup>3</sup> This result may be driven in part by SES as those with greater health literacy correlates with higher education and income.

### 5.3 Well-being Impact of Income Loss

The consequences of the COVID-19 pandemic on individuals' well-being are expected to be profound and also multi-faceted due to isolation and disruptions arising from the lockdown, as well as concerns surrounding economic loss and health risks. As such, we assess if households that experience a loss of income during the COVID-19 outbreak suffer a larger drop in well-being compared with households who do not suffer a loss of income. To do this, we identify households that experience income loss as those whose monthly income in April 2020, the peak month of COVID-19, is less than that in January 2020.

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<sup>2</sup> We also attempt to assess if there is a differential impact among individuals who report having been told they have psychiatric problems compared with those who have not. We have not presented these results as the number of individuals with psychiatric problems is too small (roughly 1% of the sample) resulting in estimates with large standard errors.

<sup>3</sup> To measure the degree of health literacy, we use a scale based on three questions originally developed by Chew et al. (2004).

Figure 4 indicates that individuals who reported a drop in household income experience a decline in overall life satisfaction almost twice as large as those who do not report any income loss. For example, Panel A presents that in May 2020, a month into the lockdown, overall life satisfaction scores decrease by 0.19 points in the former group compared with 0.10 in the latter group. Among those who experience a loss of income, we observe declines in individuals' life satisfaction with their economic situation, household income, and their daily life and job of between two-and-a-half to five times larger than that of individuals whose household income does not fall (Panels B to D). Collectively, these results suggest that the adverse economic shocks following the pandemic are key drivers of the drop in the self-reported well-being of middle-aged and older Singaporeans. It is noteworthy that life satisfaction levels also decrease among those who do not experience a drop in income, suggesting that other reasons, such as increased anxiety and stress associated with the curtailment of movement and disruption in daily activities, could play a large role in the decline in life satisfaction from the pandemic.

## 6. Concluding remarks

The COVID-19 pandemic is expected to inflict a considerable burden on the overall well-being of individuals. We examine how overall life satisfaction and domain-specific satisfaction are affected by the pandemic using monthly panel survey data of middle-aged and older Singaporeans. Our DID estimates indicate large declines in overall life satisfaction and domain satisfaction during the COVID-19 outbreak, which coincide with the introduction of a nationwide lockdown in Singapore. The mean overall life satisfaction score drops by 0.17–0.18 SD during the lockdown periods compared with the level in January 2020. These declines in life satisfaction are comparable to a drop in life satisfaction due to the occurrence of a major life event such as a major health shock or the death of a loved one (Luhmann et al., 2012; Kettlewell et al., 2020). This suggests that the strict social distancing rules in Singapore are having a large, adverse consequence on individuals' well-being despite the country's success in keeping case-fatality rates among the lowest in the world.

Our findings on the presence of heterogeneous effects can guide policymaking in the design of non-pharmaceutical interventions, such as the scope, extent, and timing of lockdown measures, to minimize the consequences of lockdowns on citizen well-being as well as on the economy (Layard et al., 2020). A significant decline in overall life satisfaction among individuals who report a drop in household income highlights the importance of measures that offer economic support for households and businesses to assist in coping with the economic

challenges brought about by the COVID-19 crisis. We also find that well-being is adversely affected even for individuals who manage to maintain their income during the pandemic. This finding suggests that economic measures must be accompanied by the introduction and expansion of health and psychological interventions to support well-being and reduce mental health risks. Further research is also needed to understand the intermediate and long-term ramifications of COVID-19 on individuals' subjective well-being.

Finally, we acknowledge that the results of this study should be applied to other contexts or age groups with caution due to the low COVID-19 fatality rate in Singapore and the older nature of our sample population. Evaluating the external validity of our findings would be a fruitful avenue for future research.

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Figure 1. Trends of Overall Life Satisfaction

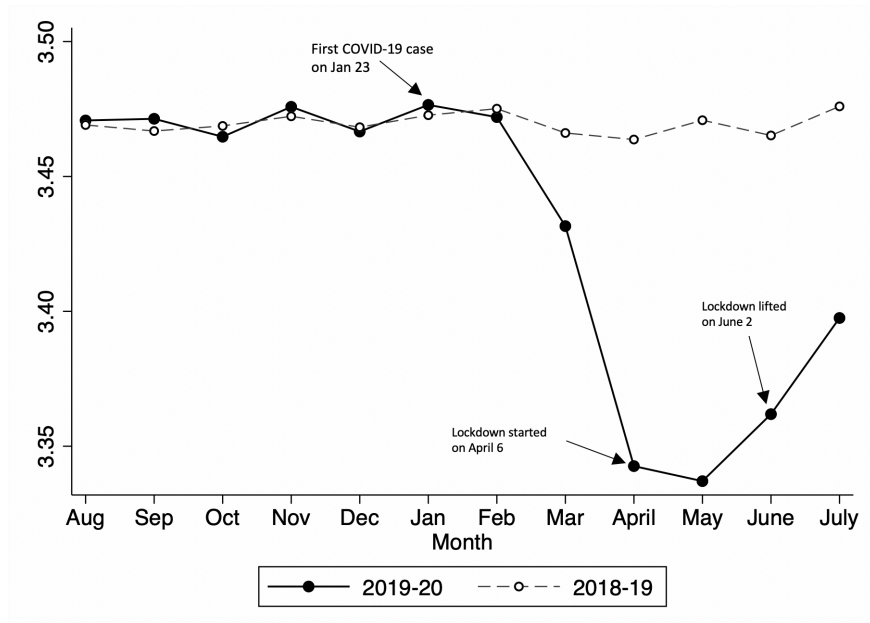
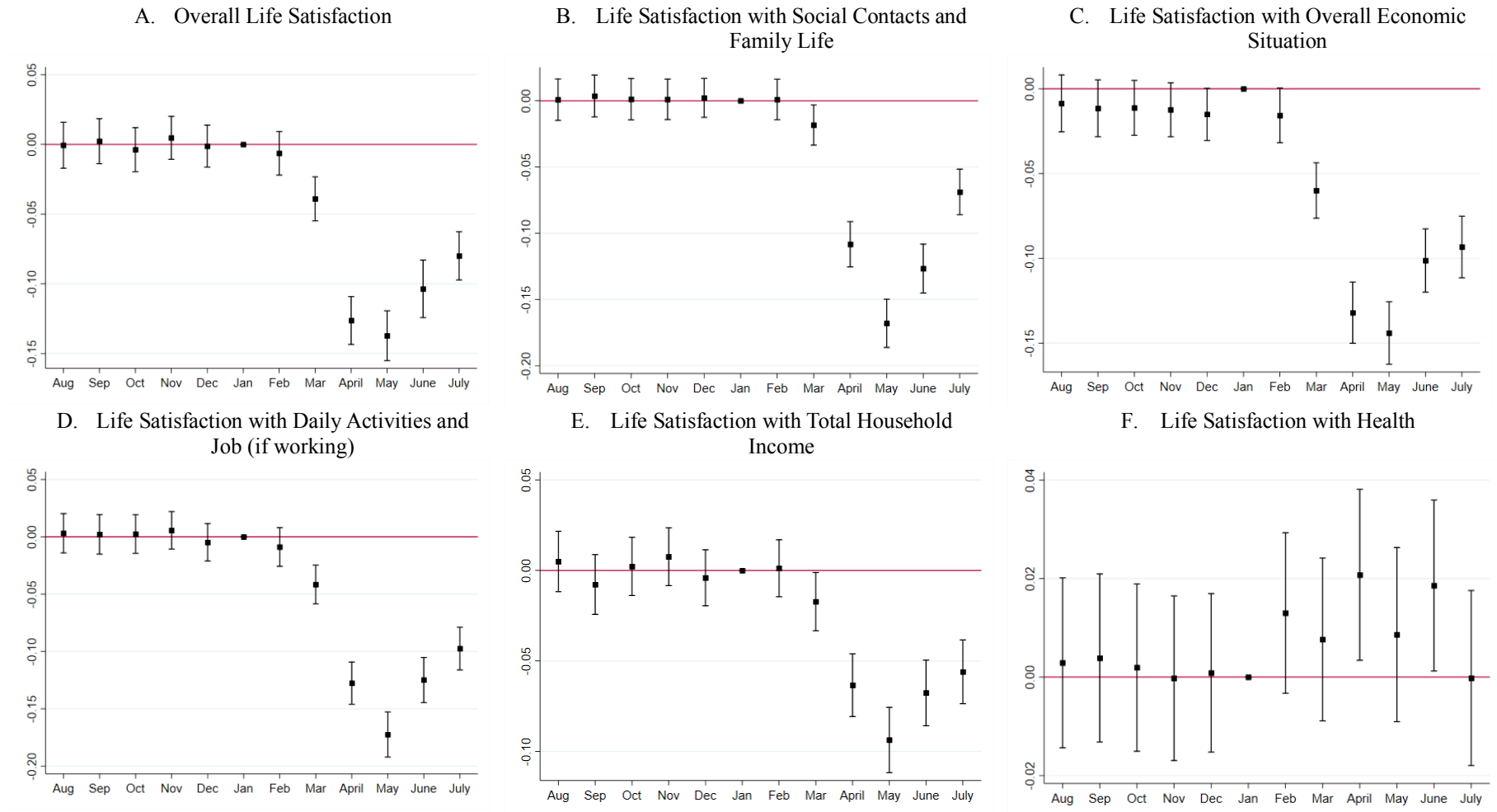


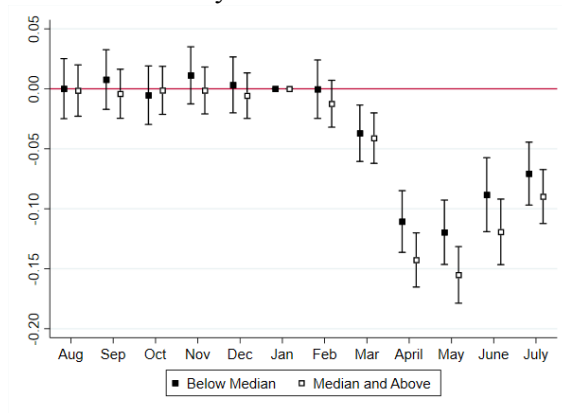
Figure 2. Effects of COVID-19 on Life Satisfaction Measures



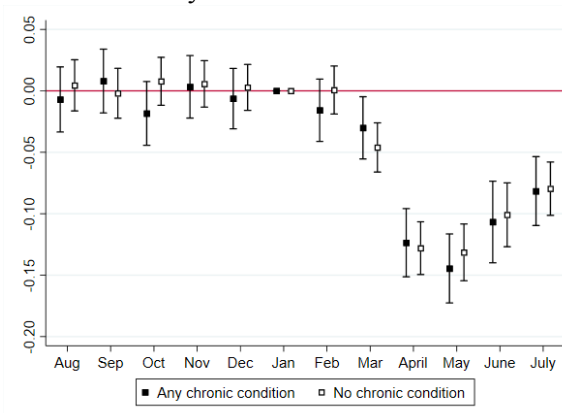
Notes. Square dots indicate DID estimates using equation (1). Caps indicate 95% confidence intervals.

Figure 3. Heterogeneous Effects of COVID-19 on Overall Life Satisfaction

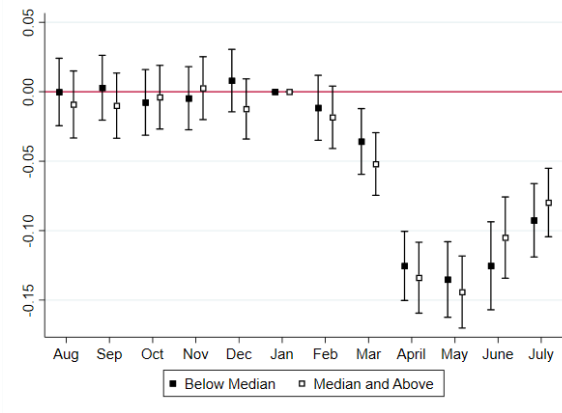
A. By household net worth



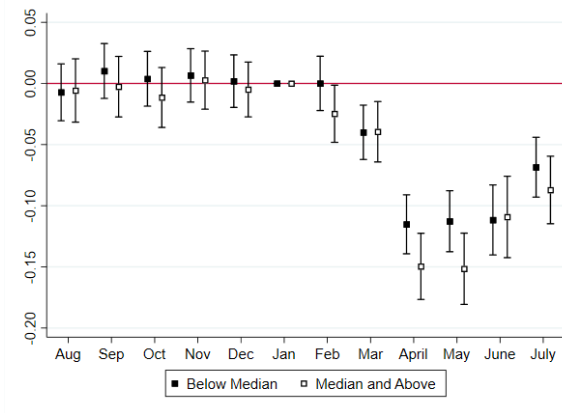
B. By chronic health conditions



C. By the degree of subjective risk aversion



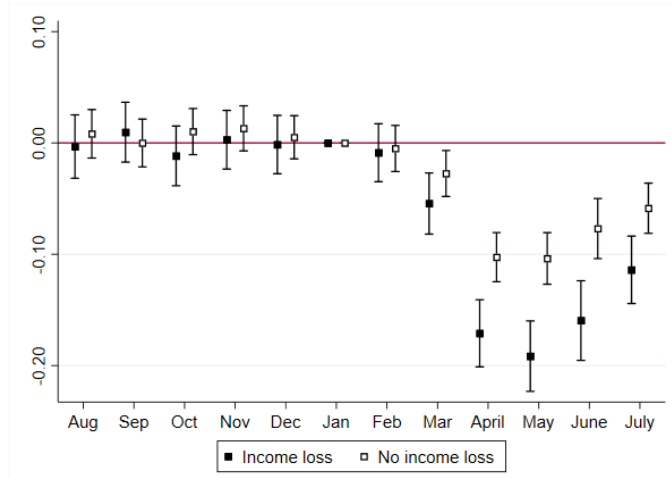
D. By health literacy



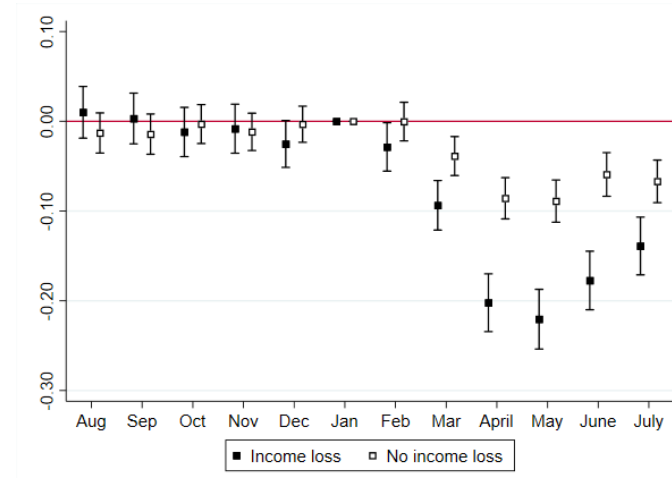
Notes. Square dots indicate DID estimates using equation (1). Caps indicate 95% confidence intervals.

Figure 4 Heterogeneous Effects of COVID-19 on Life Satisfaction by Income Loss

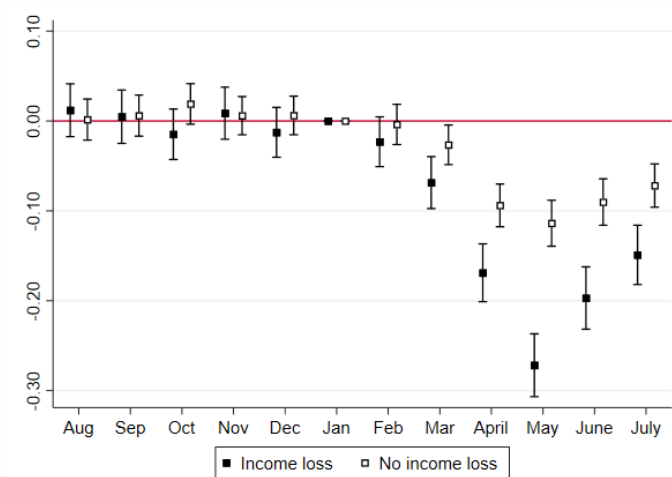
A. Overall Life Satisfaction



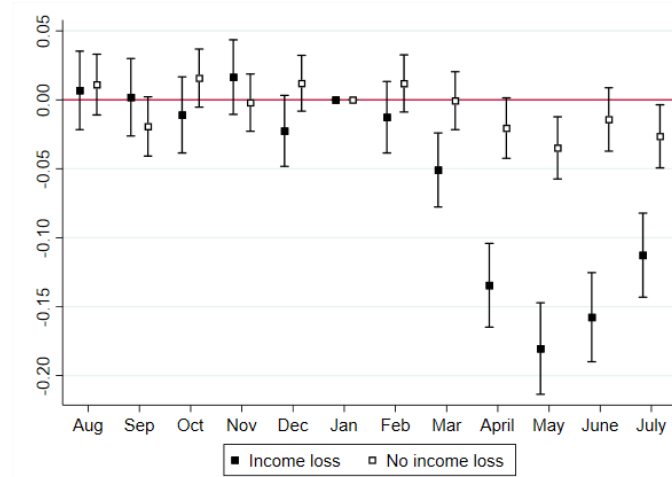
B. Life Satisfaction with Overall Economic Situation



C. Life Satisfaction with Daily Activities and Job (if Working)



D. Life Satisfaction with Total Household Income



Notes. Square dots indicate DID estimates using equation (1). Caps indicate 95% confidence intervals.



Table 1 Summary Statistics

Variables	Mean (SD)
Age	63.2 (6.41)
Male	0.47 (0.50)
Completed Secondary education	0.41 (0.49)
Completed Tertiary education	0.35 (0.48)
Ethnic Chinese	0.87 (0.34)
Married	0.79 (0.41)
Number of children	2.93 (1.14)
Household size	2.56 (1.39)
Overall life satisfaction	3.48 (0.76)
Social contacts and family life satisfaction	3.55 (0.72)
Overall economic satisfaction	3.23 (0.85)
Total household income satisfaction	3.23 (0.85)
Daily life and job satisfaction	3.42 (0.78)
Health satisfaction	3.38 (0.84)
Observations	7760

Note. Statistics are calculated based on the January 2020 SLP wave.



Table 2 Baseline Regression Results

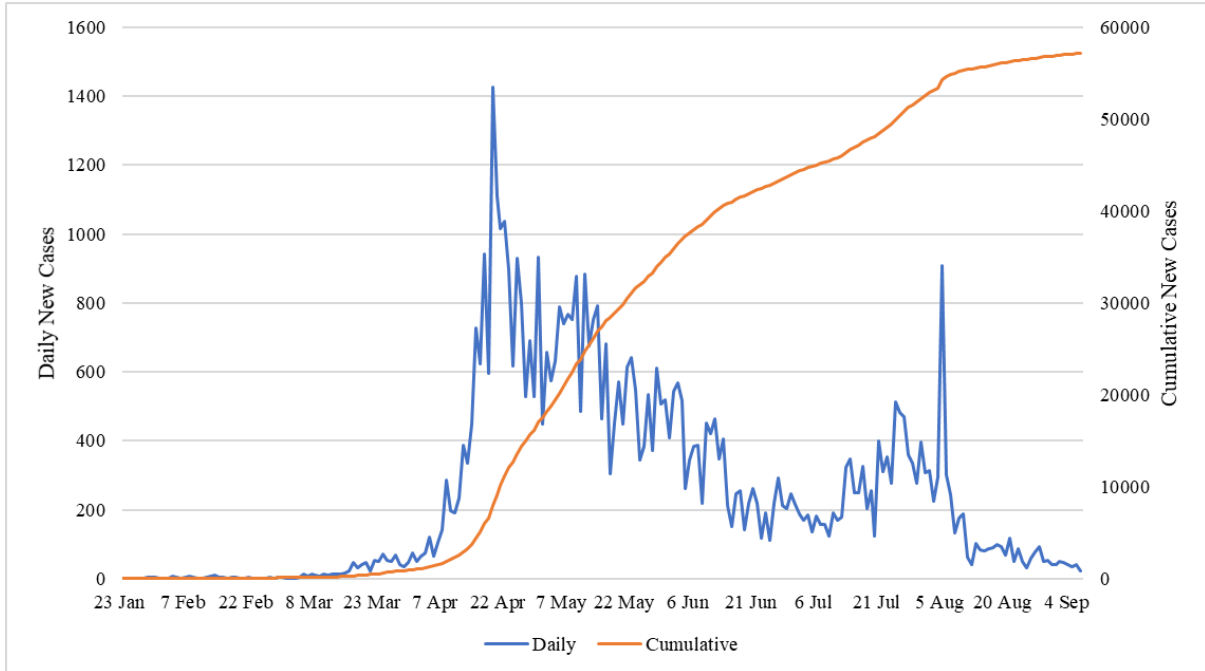
VARIABLES	(1) Overall life satisfaction	(2) Social contacts and family life satisfaction	(3) Overall economic satisfaction	(4) Total household income satisfaction	(5) Daily life and job satisfaction	(6) Health satisfaction
Feb 2020	-0.006 (0.008)	0.001 (0.008)	-0.016* (0.008)	0.001 (0.008)	-0.009 (0.009)	0.013 (0.008)
March 2020	-0.039*** (0.008)	-0.018** (0.008)	-0.060*** (0.008)	-0.017** (0.008)	-0.042*** (0.009)	0.008 (0.008)
April 2020	-0.126*** (0.009)	-0.108*** (0.009)	-0.132*** (0.009)	-0.063*** (0.009)	-0.128*** (0.009)	0.021** (0.009)
May 2020	-0.137*** (0.009)	-0.168*** (0.009)	-0.144*** (0.009)	-0.094*** (0.009)	-0.172*** (0.010)	0.009 (0.009)
June 2020	-0.104*** (0.011)	-0.127*** (0.009)	-0.101*** (0.010)	-0.068*** (0.009)	-0.125*** (0.010)	0.019** (0.009)
July 2020	-0.080*** (0.009)	-0.069*** (0.009)	-0.093*** (0.009)	-0.056*** (0.009)	-0.097*** (0.010)	-0.000 (0.009)
Observations	181,119	184,885	184,784	184,770	184,816	184,862
R-squared	0.774	0.757	0.804	0.812	0.749	0.798

Notes. Standard errors clustered at the individual level are reported in parentheses. Only the coefficient estimates between the 2019/2020 season dummy and the month dummies from February to July are displayed. Control variables include individual-fixed effects, month-fixed effects, age, age square, marital status, and household size. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

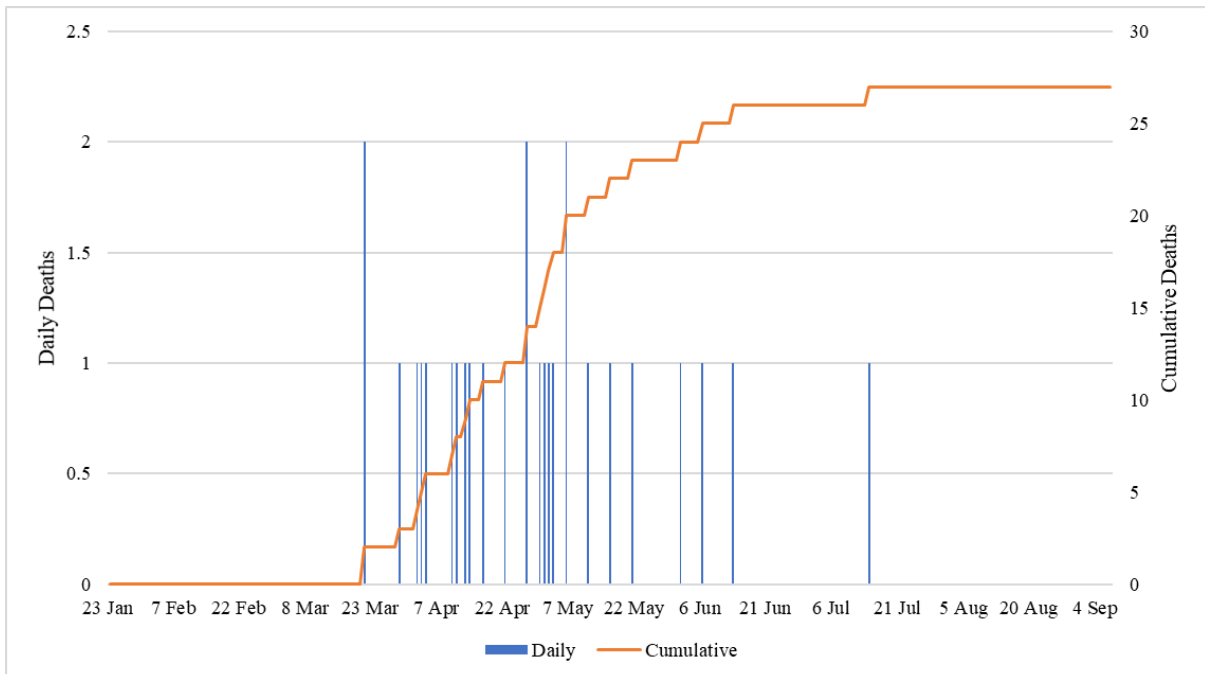
## Appendix

### Figure A1 Trends of COVID-19 infection and deaths in Singapore

#### Panel A. Trend of COVID-19 confirmed cases



#### Panel B. Trend of COVID-19 deaths



Source: Singapore Ministry of Health (2020)

Figure A2. Trends of Overall Life Satisfaction Using the Probability of Satisfied or Very Satisfied with Overall Life

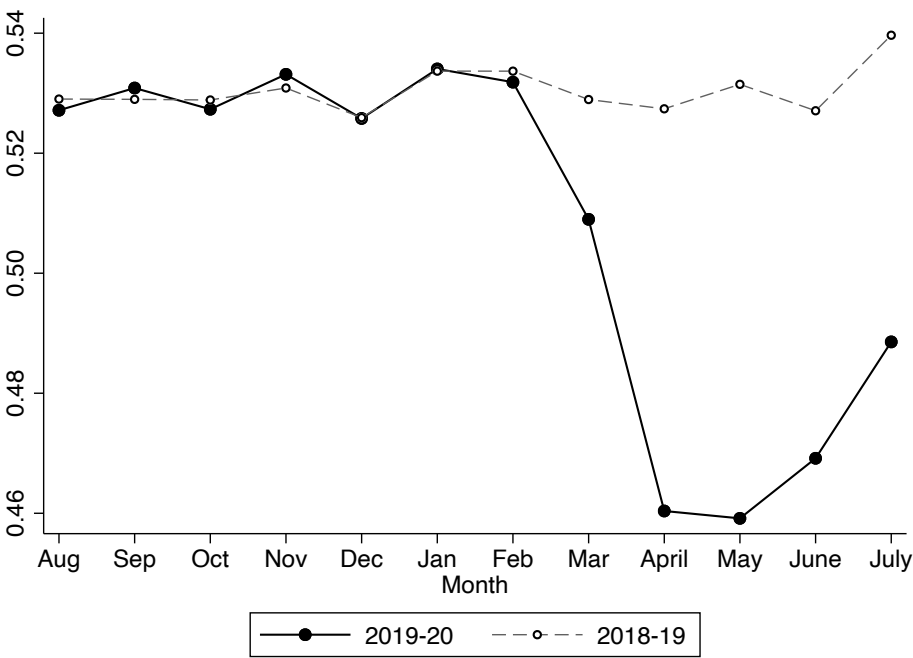
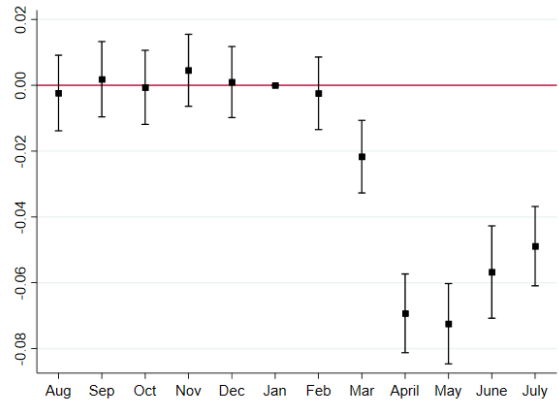
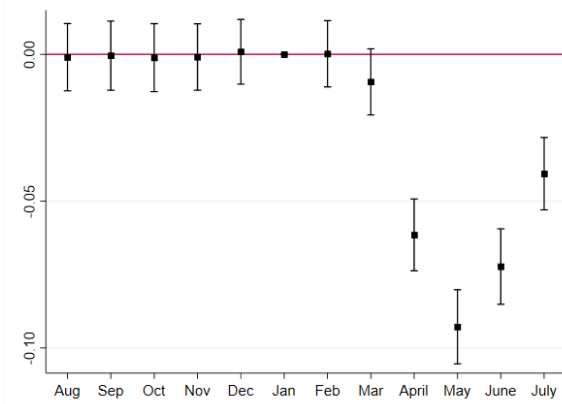


Figure A3. Effects of COVID-19 on Life Satisfaction Measures Using the Binary Indicator (Satisfied or Very Satisfied)

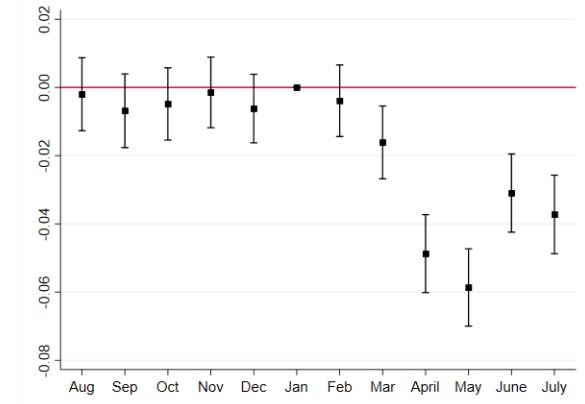
A. Overall Life Satisfaction



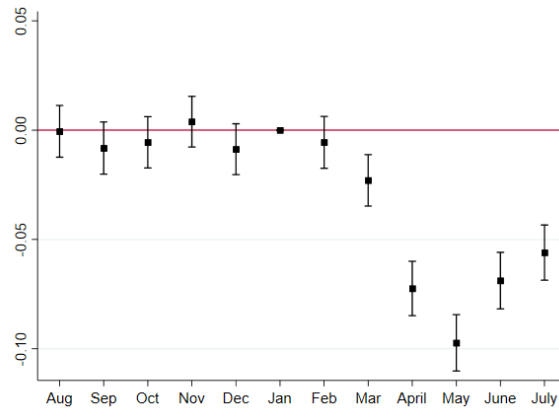
B. Life Satisfaction with Social Contacts and Family Life



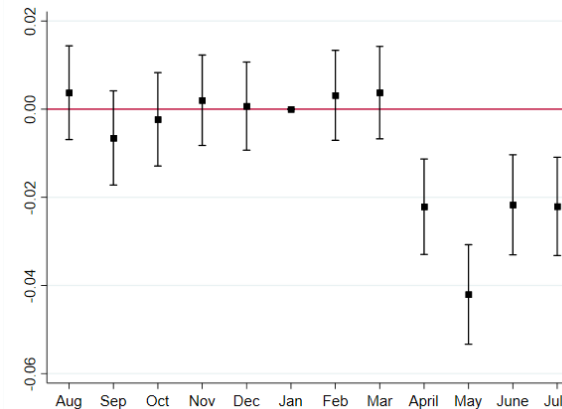
C. Life Satisfaction with Overall Economic Situation



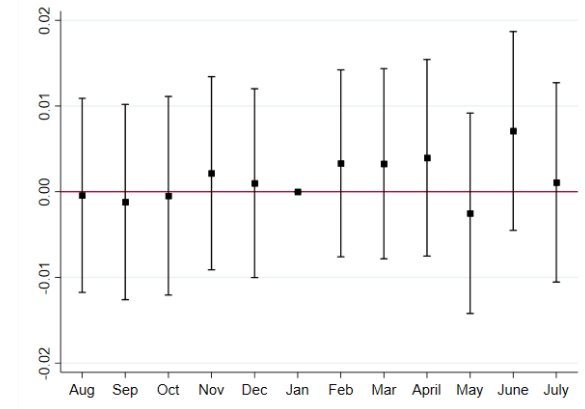
D. Life Satisfaction with Daily Activities and Job (if working)



E. Life Satisfaction with Total Household Income

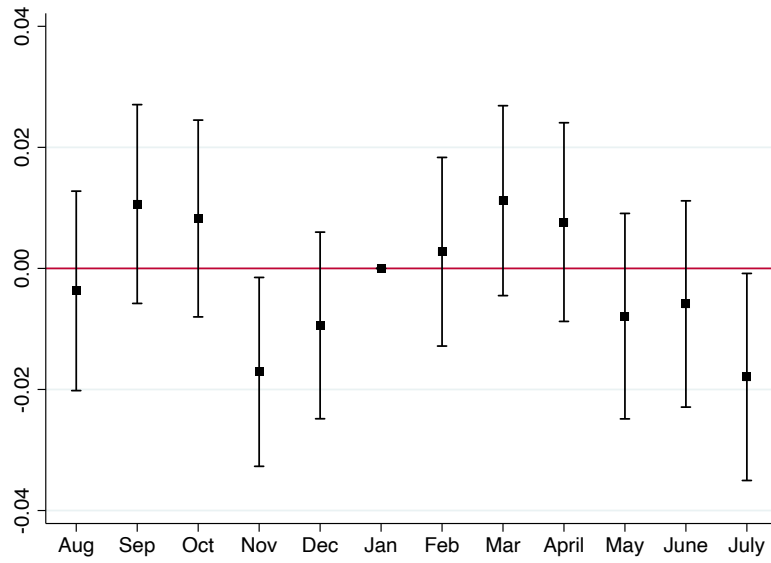


F. Life Satisfaction with Health



Notes. Square dots indicate DID estimates using equation (1). Caps indicate 95% confidence intervals.

Figure A4. Effects of COVID-19 on Self-Reported Health Status



Notes. Square dots indicate DID estimates using equation (1). Caps indicate 95% confidence intervals. This figure is an updated version of Figure 3A in Ahn et al. (2020) using data up to July 2020.

Table A1. Effects of COVID-19 on Life Satisfaction  
*Using the Heteroskedastic Ordered Probit Model*

VARIABLES	(1) Overall life satisfaction	(2) Social contacts and family life satisfaction	(3) Overall economic satisfaction	(4) Total household income satisfaction	(5) Daily life and job satisfaction	(6) Health satisfaction
Feb 2020	-0.010 (0.013)	-0.002 (0.013)	-0.020* (0.011)	0.001 (0.011)	-0.018 (0.013)	0.009 (0.012)
March 2020	-0.054*** (0.013)	-0.031** (0.013)	-0.074*** (0.012)	-0.018 (0.011)	-0.060*** (0.013)	0.006 (0.012)
April 2020	-0.177*** (0.013)	-0.164*** (0.014)	-0.164*** (0.013)	-0.078*** (0.012)	-0.178*** (0.014)	0.027** (0.012)
May 2020	-0.196*** (0.014)	-0.257*** (0.015)	-0.180*** (0.013)	-0.120*** (0.012)	-0.248*** (0.015)	0.001 (0.013)
June 2020	-0.154*** (0.019)	-0.191*** (0.015)	-0.129*** (0.013)	-0.088*** (0.012)	-0.178*** (0.015)	0.017 (0.013)
July 2020	-0.120*** (0.014)	-0.116*** (0.014)	-0.120*** (0.013)	-0.075*** (0.012)	-0.146*** (0.014)	-0.005 (0.013)
Observations	181,119	184,885	184,784	184,770	184,816	184,862

Notes. Standard errors clustered at the individual level are reported in parentheses. Only the coefficient estimates between the 2019/2020 season dummy and the month dummies from February to July are displayed. We allow heteroskedasticity by season and calendar month. Control variables include month-fixed effects, age, age square, marital status, and household size. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table A3 Heterogeneous Effects of COVID-19 on Overall Life Satisfaction

Var.	(1) By household net worth	(2) By household net worth	(3) By age	(4) By age	(5) By gender	(6) By gender	(7) By health literacy	(8) By health literacy	(9) By the degree of subjective risk aversion	(10) By the degree of subjective risk aversion	(11) By chronic health conditions	(12) By chronic health conditions
	Above median	Below Median	60 and above	Below 60	Male	Female	Above median	Below Median	Above median	Below Median	Yes	No
Feb 2020	-0.012 (0.010)	-0.000 (0.012)	-0.011 (0.010)	0.000 (0.013)	-0.017 (0.012)	0.004 (0.011)	-0.025** (0.012)	0.000 (0.011)	-0.012 (0.012)	-0.018 (0.011)	-0.016 (0.013)	0.001 (0.010)
March 2020	-0.041*** (0.011)	-0.037*** (0.012)	-0.042*** (0.010)	-0.035*** (0.013)	-0.041*** (0.012)	-0.037*** (0.011)	-0.039*** (0.013)	-0.040*** (0.011)	-0.036*** (0.012)	-0.052*** (0.012)	-0.030** (0.013)	-0.046*** (0.010)
April 2020	-0.143*** (0.012)	-0.111*** (0.013)	-0.126*** (0.011)	-0.127*** (0.014)	-0.123*** (0.013)	-0.129*** (0.012)	-0.150*** (0.014)	-0.115*** (0.012)	-0.125*** (0.013)	-0.134*** (0.013)	-0.124*** (0.014)	-0.128*** (0.011)
May 2020	-0.155*** (0.012)	-0.120*** (0.014)	-0.137*** (0.011)	-0.138*** (0.015)	-0.136*** (0.013)	-0.138*** (0.013)	-0.152*** (0.015)	-0.113*** (0.013)	-0.135*** (0.014)	-0.144*** (0.013)	-0.145*** (0.014)	-0.131*** (0.012)
June 2020	-0.119*** (0.014)	-0.088*** (0.016)	-0.105*** (0.013)	-0.102*** (0.018)	-0.093*** (0.015)	-0.114*** (0.015)	-0.109*** (0.017)	-0.112*** (0.015)	-0.125*** (0.016)	-0.105*** (0.015)	-0.107*** (0.017)	-0.101*** (0.013)
July 2020	-0.090*** (0.011)	-0.071*** (0.013)	-0.084*** (0.011)	-0.074*** (0.014)	-0.076*** (0.013)	-0.084*** (0.012)	-0.087*** (0.014)	-0.068*** (0.012)	-0.093*** (0.013)	-0.080*** (0.013)	-0.082*** (0.014)	-0.080*** (0.011)
Observations	90,302	89,991	111,236	69,883	85,010	96,051	64,292	90,259	75,872	82,349	79,449	101,505
R-squared	0.782	0.760	0.776	0.771	0.797	0.750	0.785	0.774	0.784	0.783	0.752	0.789

Notes. Standard errors clustered at the individual level are reported in parentheses. Only the coefficient estimates between the 2019/2020 season dummy and the month dummies from February to July are displayed. Control variables include individual-fixed effects, month-fixed effects, age, age square, marital status, and household size. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table A4 Heterogeneous Effects of COVID-19 on Life Satisfaction by Income Loss

Var.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Overall life satisfaction		Overall economic satisfaction		Total household income satisfaction		Daily life and job satisfaction	
Income Loss Status	Yes	No	Yes	No	Yes	No	Yes	No
Feb 2020	-0.009 (0.013)	-0.005 (0.011)	-0.029** (0.014)	-0.000 (0.011)	-0.013 (0.013)	0.012 (0.011)	-0.023 (0.014)	-0.004 (0.011)
March 2020	-0.054*** (0.014)	-0.027*** (0.011)	-0.094*** (0.014)	-0.039*** (0.011)	-0.051*** (0.014)	-0.001 (0.011)	-0.069*** (0.015)	-0.027** (0.011)
April 2020	-0.171*** (0.015)	-0.103*** (0.011)	-0.202*** (0.016)	-0.086*** (0.012)	-0.135*** (0.015)	-0.021* (0.011)	-0.169*** (0.016)	-0.094*** (0.012)
May 2020	-0.191*** (0.016)	-0.104*** (0.012)	-0.221*** (0.017)	-0.089*** (0.012)	-0.180*** (0.017)	-0.035*** (0.012)	-0.272*** (0.018)	-0.114*** (0.013)
June 2020	-0.159*** (0.018)	-0.077*** (0.014)	-0.177*** (0.017)	-0.059*** (0.012)	-0.158*** (0.016)	-0.014 (0.012)	-0.197*** (0.018)	-0.090*** (0.013)
July 2020	-0.114*** (0.015)	-0.059*** (0.011)	-0.139*** (0.016)	-0.067*** (0.012)	-0.113*** (0.016)	-0.026** (0.012)	-0.149*** (0.017)	-0.072*** (0.012)
Observations	58,696	98,578	59,963	100,606	59,958	100,605	59,956	100,599
R-squared	0.764	0.788	0.808	0.812	0.810	0.823	0.738	0.764

Notes. Standard errors clustered at the individual level are reported in parentheses. Only the coefficient estimates between the 2019/2020 season dummy and the month dummies from February to July are displayed. Control variables include individual-fixed effects, month-fixed effects, age, age square, marital status, and household size. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.