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ORIGINAL PAPER

The Impact of Daycare Closures Owing to COVID-19 on Parental Stress: The Case of Japan

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Abstract
The purpose of this study is to quantify the effect of the closure of daycare facilities during the early stage of the coronavirus disease 2019 pandemic on the stress of parents with preschool children. Using household panel data collected before and after the pandemic, we estimated difference-in-differences models and their extensions. Our empirical results show that the closure of daycare facilities significantly worsened parental stress as measured by the Kessler Psychological Distress Scale. The negative effects of daycare closures on parental stress levels were greater for mothers, non-regular workers, and households with relatively older children. In contrast, on parents in metropolitan areas or those with younger children, no significant effects of daycare closures were observed. We discuss the two conflicting pathways—the increased childcare burden and the decreased risk of children's infection—through which daycare closures affected parental distress, interpret the heterogeneous effects accordingly, and provide policy implications. Our results suggest that a risk-based, local closure policy could have been effective in reducing parental stress during the emergency.

Keywords COVID-19 · State of emergency · Daycare closures · Parental stress · Kessler Psychological Distress Scale · Difference-in-differences

Introduction

The global coronavirus disease 2019 (COVID-19) pandemic led governments in many countries to close educational facilities temporarily. In Japan, elementary and junior high schools were closed by a government order during the first state of emergency between April 17 and May 31, 2020. However, preschool daycare facilities were not asked to close in some cases.[1] Unlike the closure of all elementary and junior high schools initiated in March 2020, daycare closures were based on the voluntary decision of each facility or at the "request" of the local government. As a result, some households unexpectedly lost access to childcare services, while others could use them even during the state of emergency.

In this study, we aim to quantify the impact of the closure of daycare facilities on parental distress during the COVID-19 pandemic in Japan. There are at least two pathways through which the closure of daycare facilities affected parental distress. First, the closure of daycare facilities unexpectedly changed families' childcare arrangements, at least temporarily. Daycare closures would have increased the childcare burden on families who had previously used these

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[1] In Japan, there are two types of institutions in early childhood education and care: kindergartens (*yochien* in Japanese) and nursery schools (*hoikuen* in Japanese). Kindergartens are under the jurisdiction of the Ministry of Education, Culture, Sports, Science and Technology and are mainly for the purpose of education. Nursery schools are under the jurisdiction of the Ministry of Health, Labour and Welfare and are mainly for the purpose of childcare. In this study, unless otherwise mentioned, kindergartens and nursery schools are collectively referred to as daycare facilities.

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childcare services, potentially worsening parental well-being and stress. In particular, working couples with preschool children, who need to juggle work and childcare, were most likely affected by such changes in childcare arrangements.[2]

Second, at least in the early phase of the pandemic, it was virtually impossible for parents to properly assess the risk of infection for their children and themselves. Under such circumstances, daycare facility closures would have reduced parents' anxiety toward infection by keeping their children at home. In other words, home may have served as a "shelter" for families with young children. The abovementioned two pathways would have influenced parental stress in opposite directions. Thus, whether and to what extent the closure of daycare facilities affected parental well-being and distress depends on the relative importance of these two pathways.

There is a small but rapidly growing body of literature on how childcare arrangements during the pandemic affected parental well-being and distress (see next section for details). These studies indicate that the closure of schools or daycare facilities deteriorated parents' mental health in many countries (Takaku & Yokoyama, 2021; Yamamura & Tsustsui, 2021a; Yokoyama & Takaku, 2021 for Japan; Huebener et al., 2021 for Germany; and Wu et al., 2020 for China). Nonetheless, not all previous studies have shown that the closure of schools/daycare facilities or the provision of emergency services therein, significantly impacted parents' mental health. For example, Schüller and Steinberg (2022) showed that emergency childcare provision in Germany did not considerably influence parental well-being. Given two conflicting pathways, school or daycare closures may have only a negligible impact on parental distress.

Our paper differs from existing studies in the following ways. First, we aim to understand how the two conflicting pathways contributed to the overall impact of daycare closures on parental distress. Our empirical results show that the relative importance of the two pathways may differ significantly depending on location or individual/household characteristics, yielding heterogeneous effects of the daycare closure. This finding has policy implications in that closing all daycare facilities regardless of the situation (e.g., lockdown) may not have been efficient and that Japan's daycare closure policy, granting discretion to each facility, can be justified to some extent.

Second, by utilizing the panel structure of our dataset, we carefully controlled for changes in respondents' employment status, family income, and health status. Previous studies mainly used cross-sectional surveys administered after the COVID-19 pandemic.[3] As a result, they could not reflect changes in parental or family characteristics. Controlling for these time-varying characteristics is particularly important in our context, as the pandemic affected not only the operation of schools and daycare facilities, but also parents' employment and health status.

Third, we estimated panel difference-in-differences (DID) models to identify the impact of daycare closures on parental distress. Introducing household fixed effects eliminates pre-existing, time-invariant unobserved differences across households. Hence, our identification hinges on the parallel trends assumption, meaning that the stress levels of treated parents (i.e., those who experienced daycare closures) would have evolved in parallel with those of untreated parents in the absence of treatment. One may think, however, that this assumption does not hold in our context. Existing evidence suggests that the adverse impact of the pandemic on employment and earnings tended to be greater for female, low-skilled, or part-time workers (Fukai et al., 2021; Kikuchi et al., 2021). To address this issue, we augmented the standard DID models by introducing time-by-covariate interactions. Specifically, our model allowed for differential trends depending on key pretreatment covariates such as age, gender, education, and employment status. Furthermore, we controlled for potential time-varying confounders such as the number of newly reported COVID-19 cases and the "stay-home" rate in each prefecture.

Our empirical findings are summarized as follows. We found that the closure of daycare facilities during the first state of emergency worsened parental distress. Our results show that daycare facility closures increased scores on the Kessler Psychological Distress Scale (K6), our measure of parental stress, by about 1.2 points when we controlled for a full set of covariates. These results were robust to the covariate selections and alternative treatment definitions. We also found that treatment effects exhibited substantial heterogeneity. The negative effects of daycare closures on parental stress levels were substantially larger for mothers, non-regular workers, and households with relatively older children. Conversely, we did not find significant effects of daycare facility closures for parents in metropolitan areas, where the COVID-19 situation was severe, or for those with younger children, thought to be the most vulnerable population. We argue that heterogeneous treatment effects are consistent with the two conflicting pathways discussed earlier.

This paper is structured as follows. We briefly review previous studies in "Review of Related Literature." In "Data,"

[2] As in many other countries, the number of working couples has been steadily increasing in Japan. According to the 2020 Labour Force Survey, about 37.3% of married couples with preschool children were dual earners.

[3] An exception is Schüller and Steinberg (2022). They used German panel data covering periods before and after the pandemic, showing insignificant effects of emergency childcare provision on parental well-being. Huebener et al. (2021) employed a DID approach, but used repeated cross-sections; therefore, data on changes in employment or health status for each parent were not available.

we explain our dataset and variables. In "Method of Analysis," we present empirical models and key identification strategies. In "Results," we present empirical findings and a discussion. The last section concludes the paper and highlights policy implications.

Review of Related Literature

School Closures During the Pandemic

It is widely believed that the COVID-19 pandemic adversely impacted parents' mental health and well-being. The World Health Organization (2020) reported that movement restrictions, school closures, and income loss heightened stress and anxiety levels in parents, caregivers, and children.[4]

Several recent studies documented the negative impact of school and daycare closures on parental distress. Huebener et al. (2021) examined how the total closure of schools and daycare facilities during the lockdown in Germany affected parents' well-being. Using a DID approach, they compared households with and without children, showing that the well-being of parents, especially mothers of young children, decreased significantly when schools and daycare facilities were closed during the lockdown.[5] Similarly, Wu et al. (2020), using an Internet household survey in China, found that parents, especially mothers of elementary school-aged children, felt more stress.[6] In contrast, Schüller and Steinberg (2022) showed that emergency childcare provision in Germany did not considerably influence parental well-being while reducing potentially harmful parenting behavior.

In Japan, Takaku and Yokoyama (2021) and Yokoyama and Takaku (2021) showed that school and daycare closures during the pandemic deteriorated mothers' mental health. These two papers used the same online survey data and shared similar research questions but adopted different identification strategies. Takaku and Yokoyama (2021) compared the mothers of preschool and elementary school children who faced different school closure situations. As mentioned, the Japanese government closed all elementary schools in March 2020, whereas daycare facilities were exempted from this nationwide school closure policy. Their regression discontinuity estimates using children's age in months as a running variable revealed that elementary school closures increased maternal anxiety over how to raise their children. Yokoyama and Takaku (2021), using a sample of preschool-aged children and their mothers, examined the impact of preschool (non-)attendance during the pandemic on mothers' psychological distress. Using preschool closure as an instrumental variable for a child's non-attendance, they found that children's absence from preschool negatively affected mothers' psychological distress. Yamamura and Tsustsui (2021a) also examined the impact of school closures on parents' mental health, using a sample of elementary/junior high school children and their parents drawn from short panel data from mid-March to mid-April 2020.[7] They calculated the prefecture-level school closure rate for each of the five waves and examined whether the school closure rate affected parental mental health. They found that school closures deteriorated the mental health of less educated mothers with elementary school children, but did not affect the mental health of more educated mothers or mothers with junior high school children.

As mentioned in the previous section, there are at least two distinct pathways through which school closures could have influenced parental stress and well-being. On one hand, school closures forced parents to take care of their children at home, potentially *increasing* the stress of working parents by making it difficult to balance work and childcare. On the other, school closures would have lowered the risk of children's infection, potentially *decreasing* parental stress, particularly when the infection situation was severe or when parents cared more about the risk of their children's infection.

The relative importance of these two pathways has currently not been fully addressed. As a result, studies show that school/daycare closure has a negative impact on parental stress and well-being through these two conflicting pathways. Exploiting the rich set of household characteristics both before and after the pandemic, we aim to better understand the impact of daycare closures on parental stress focusing explicitly on these different pathways.

[4] While our primary interest in this paper is the impact of the COVID-19 pandemic on parental stress, many studies have also investigated the impact of the pandemic on child abuse and neglect. Despite the general perception that the pandemic would have increased child abuse and neglect, these studies show that the number of related emergency department visits substantially decreased during the pandemic (Arons, 2022; Sege & Stephens, 2022; Swedo et al., 2020). In Japan, Nomura et al. (2022) showed that fathers increased their involvement with their children during the pandemic, and an increase in mothers' parenting burden was also observed.

[5] They combined two cross-sectional surveys to estimate the DID models. They used the German Socio-Economic Panel for pre-COVID data (2018) and COMPASS survey for post-COVID data (2020).

[6] Other studies also found that the pandemic increased the likelihood of child abuse, neglect, and maltreatment (Brown et al., 2020; Griffith, 2022; Lawson et al., 2020).

[7] Yamamura and Tsustsui (2021b) analyzed the impact of the presence of their children at home owing to the school closure on telecommuting during the first state of emergency based on the same data. They showed that mothers tended to work at home and care for their children, and fathers tended to work in the office and spend less time taking care of their children.

Childcare Programs and Parental Well-Being

Broadly, our paper relates to studies on the effect of center-based formal childcare on parental stress and well-being. While numerous studies have investigated the effect of formal childcare on child development, mothers' labor supply, and households' fertility decisions, few have addressed its effect on parental stress and well-being.[8] Furthermore, existing studies have not reached a consensus on its impact on parental stress and well-being.

Baker et al. (2008) examined the impact of Canadian universal childcare on mothers' labor supply and parental well-being. Their findings suggest that universal childcare increases maternal labor supply, but worsens parent–child relationships and mothers' mental health. Ryser and Heers (2022) also found that formal or mixed childcare arrangements in Switzerland tend to have a negative impact on parental well-being.

In contrast, several studies have shown that formal childcare and early childhood education improve children's cognitive and non-cognitive skills, especially for those from disadvantaged families (Heckman et al., 2013). Yamaguchi et al. (2018), using the Longitudinal Survey of Newborns in the 21st century, examined how childcare enrollment affects children and their parents. They found that children of less educated mothers developed better language skills and showed reduced inattention, hyperactivity, and aggression if they attended daycare facilities. Related to the present paper, they also found that childcare use improved parenting quality and reduced the stress of disadvantaged mothers.[9]

A major empirical challenge in existing studies is the endogenous selection of children into formal childcare arrangements. The pandemic forced some parents to change their childcare arrangements from center-based formal care to home-based care. Taking advantage of this natural experiment, we examined how formal childcare affected parental stress in an emergency situation.

Data

Japan Household Panel Survey and the Supplement Module on COVID-19

The data we analyzed were drawn from the Japan Household Panel Survey (JHPS) and First JHPS COVID-19 Special Survey (JHPS-COVID19) conducted in January and May 2020, respectively. The JHPS is an annual household survey started in 2004 as the Keio Household Panel Survey. It explores a wide range of household and individual characteristics including household composition, employment, education, income, consumption, health, and housing.

In the wake of the COVID-19 pandemic, the JHPS-COVID19 was conducted as an additional survey to the JHPS sample in May 2020. A total of 5470 JHPS respondents were asked to participate in the JHPS-COVID19, with a response rate of 70.5% ($N = 3857$). The JHPS-COVID19 was conducted to understand the situation during the emergency, asking specific questions related to the pandemic. We used the sample from the most recent JHPS conducted in January 2020 and JHPS-COVID19 conducted in mid-May 2020 to analyze the impact of daycare closures during the pandemic on parental distress. These two surveys provided data on household situations before and after the first state of emergency and its resulting daycare closures. This is a major difference from previous studies that used data drawn from online surveys conducted after the pandemic (Takaku & Yokoyama, 2021; Yamamura & Tsustsui, 2021a, 2021b; Yokoyama & Takaku, 2021). We restricted our sample to JHPS respondents with at least one preschool child. After eliminating observations with missing information, our dataset included 258 households.[10]

The survey period of the JHPS was from the end of January to end of February 2020. The number of infected persons with COVID-19 in Japan during this period was only 215.[11] This implies that the impact of COVID-19 on households' economic activities at the time of the JHPS survey was fairly limited. In fact, the consumption expenditure for households with two or more persons in February 2018, 2019, and 2020 showed that the pandemic had no impact in February 2020 (Fig. 1). In the following analysis, we assume that the JHPS reflects the household situation before the pandemic, meaning that households were unaffected by the pandemic.

[8] In the child development literature, the effect of formal childcare on child behavior and mental health has been widely studied. These studies indicate that in general, formal childcare worsens children's behavioral problems and mental distress (Gunnar et al., 2010; McCartney et al., 2010). However, these adverse impacts are moderated by children's personality traits (Johnson et al., 2019), parent–child relationships (Ahnert & Lamb, 2003), and the quality of care (Belsky et al., 2007; Gunnar & Donzella, 2002; Love et al., 2003). Vermeer and IJzendoom (2006) provide an early review of the literature.

[9] Hart et al. (2023) also examined the relationship between childcare quality and maternal depression. They found that while better quality of childcare improves mothers' mental health, the effect tends to be small and statistically insignificant.

[10] There were 311 households with preschool children in the JHPS-COVID-19, but households with missing values in the covariates were excluded from the study sample.

[11] Dashboard and map of COVID-19 Japan by J. A. G Japan Co., Retrieved from https://gis.jag-japan.com/covid19jp/.

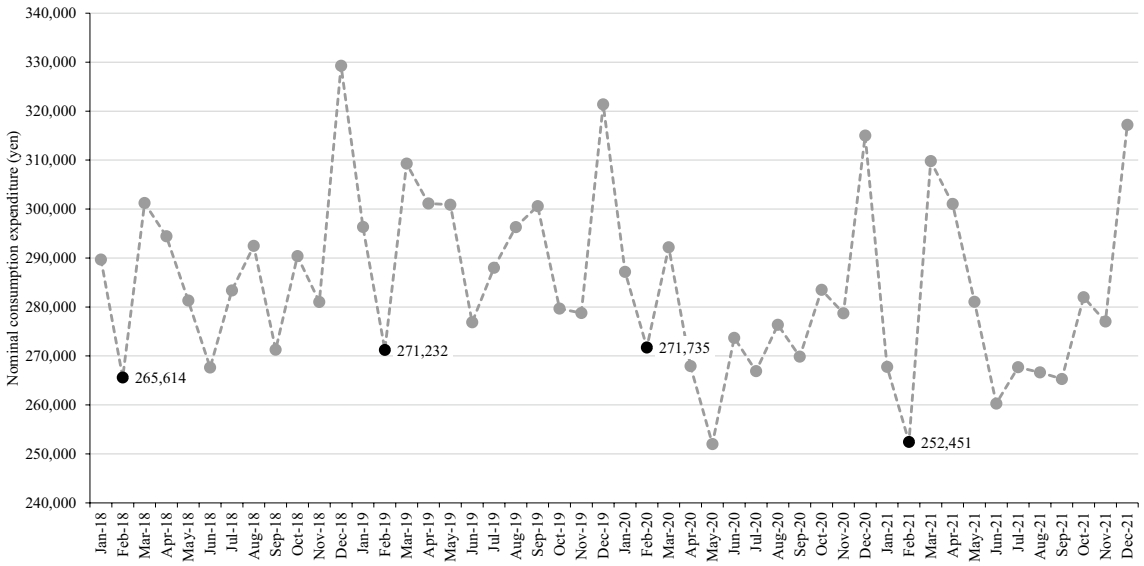

Fig. 1 Nominal consumption expenditure of households with two or more members. Source: Ministry of Internal Affairs and Communications (2022)

Table 1 Definitions of the treatment variable

	Options	n	%	Treatment indicator
1	Never attended daycare facilities	56	22	0
2	Attended daycare facilities without experiencing any closures	34	13	0
3	Refrained from going to daycare facilities even though they were open	70	27	0
4	Did not attend daycare facilities owing to closure in April	98	38	1
	Total	258	100	

Variables

Treatment Variables

In the JHPS-COVID19, households with children aged 6 years or younger as of April 2020 were asked about their childcare situation.[12] The question was: "Have there been any closures of daycare facilities that your child attends since April 2020?" Respondents were asked to select one of the following options: (1) never enrolled in daycare facilities; (2) attended daycare facilities without experiencing any closures; (3) refrained from going to daycare facilities even though they were open; (4) not attending daycare facilities owing to closure up until now; and (5) did not attend daycare facilities owing to closure for a period, but now going to daycare facilities again. As a result, households that experienced daycare closures chose options (4) or (5).

Table 1 shows our definition of the treatment and control groups based on the responses to this question. The treatment group was households whose children did not attend daycare facilities owing to unexpected closures during the first state of emergency. The control group comprised households whose children never attended daycare facilities, those who kept going to the facilities without experiencing any closures, or those who refrained from going to the facilities even though they were open. Based on the responses to the aforementioned question, the treatment indicator was set to 1 for households that answered (4) or (5) and 0 for households that answered (1), (2), or (3).

Outcome Variables

Our key outcome variable was parental stress measured by the K6 (Kessler et al., 2002). The K6 is a widely used self-reported measure of psychological distress that assesses

[12] If a household had more than one child aged 6 years or younger, the question asked about the childcare situation for the oldest child aged 6 or younger.

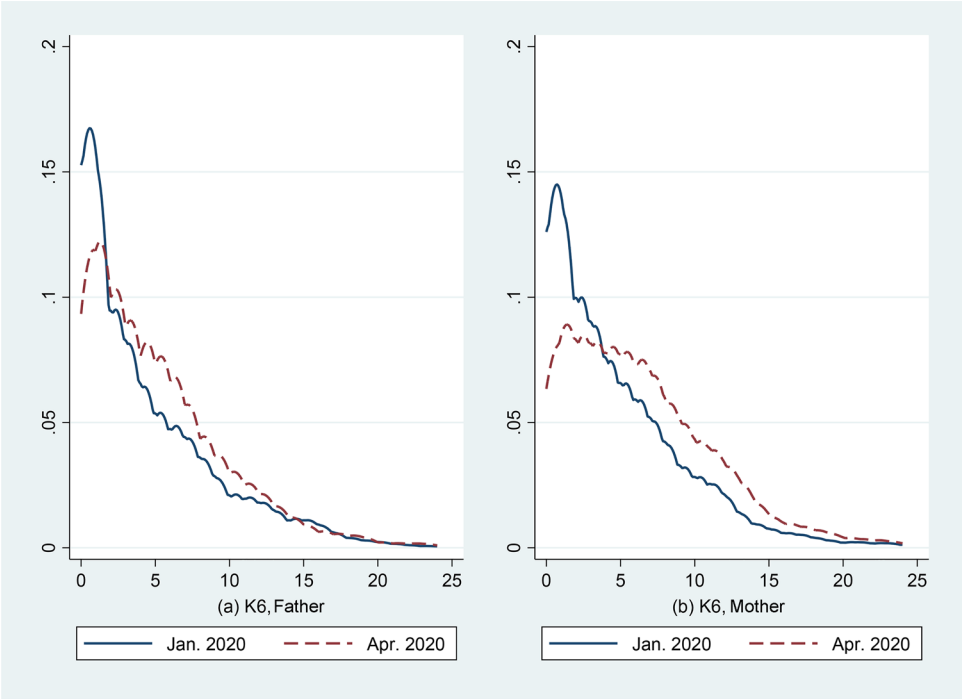

Fig. 2 Distributions of Kessler Psychological Distress Scale scores in January and April 2020

individual risk of serious mental disorders such as depression and anxiety. The K6 is constructed from six different survey items about feelings or experiences during the past 30 days.[13] These six items ask respondents to rate how often in the past 30 days they felt: (1) nervous, (2) hopeless, (3) restless or fidgety, (4) so depressed that nothing could cheer them up, (5) that everything was an effort, and (6) that everything was worthless. A 5-point Likert scale is used to measure responses as follows: 0 (never), 1 (a small period of time), 2 (some time), 3 (most of the time), and 4 (all of the time). Responses to these six items are summed up to yield a K6 score, with a higher score indicating poorer mental health.

Figure 2 illustrates the distributions of the K6 score in January and April 2020 for both fathers and mothers. Panel (a) shows the K6 distributions for fathers and panel (b) those for mothers. For both fathers and mothers, we see that the distribution of K6 scores in April has a thicker right tail than that in January, meaning that parents' stress worsened during the pandemic. Furthermore, although the COVID-19 pandemic increased stress levels for both fathers and mothers, the adverse impact seemed more severe for mothers.

Figure 3 compares the average K6 scores of the treatment and control groups. Panel (a) shows that the average K6 scores in January were almost the same for the treatment and control parents. In contrast, panel (b) shows that the average K6 score for treatment parents increased to become higher than that for the control parents in May.

Covariates

Table 2 shows the descriptive statistics. Outcome and treatment variables are tabulated in Panel A. Control variables were divided into three categories: pretreatment covariates in Panel B, time-varying covariates in Panel C, and COVID-19-related covariates aggregated at the prefectural level in Panel D.

Pretreatment covariates were used to control for initial differences in household characteristics related to the general effects of the pandemic (see "Identification Strategy" for details). All these covariates were from the JHPS conducted in January 2020. Pretreatment covariates included the respondent's age, gender, education, parents' employment status, child's age, number and composition of household members, caregiving status for older adults, and household's location of residence. For respondents' age, we created dummy variables for four categories: ≤29, 30–34, 35–39, and ≥40. We used four dummy variables for parents' employment status: (a) dual-earner parents where both mother and father were regular employees, (b) dual-earner parents where either mother or father were regular employees, (c) dual-earner households where both mother and father were non-regular workers, and (d) single-earner parents where either mother or father was employed. For the

[13] The K6 in the JHPS evaluated parental stress in January 2020. The K6 in the JHPS-COVID19 evaluated parental stress from early April to early May (mostly in April), because the survey was conducted in mid-May.

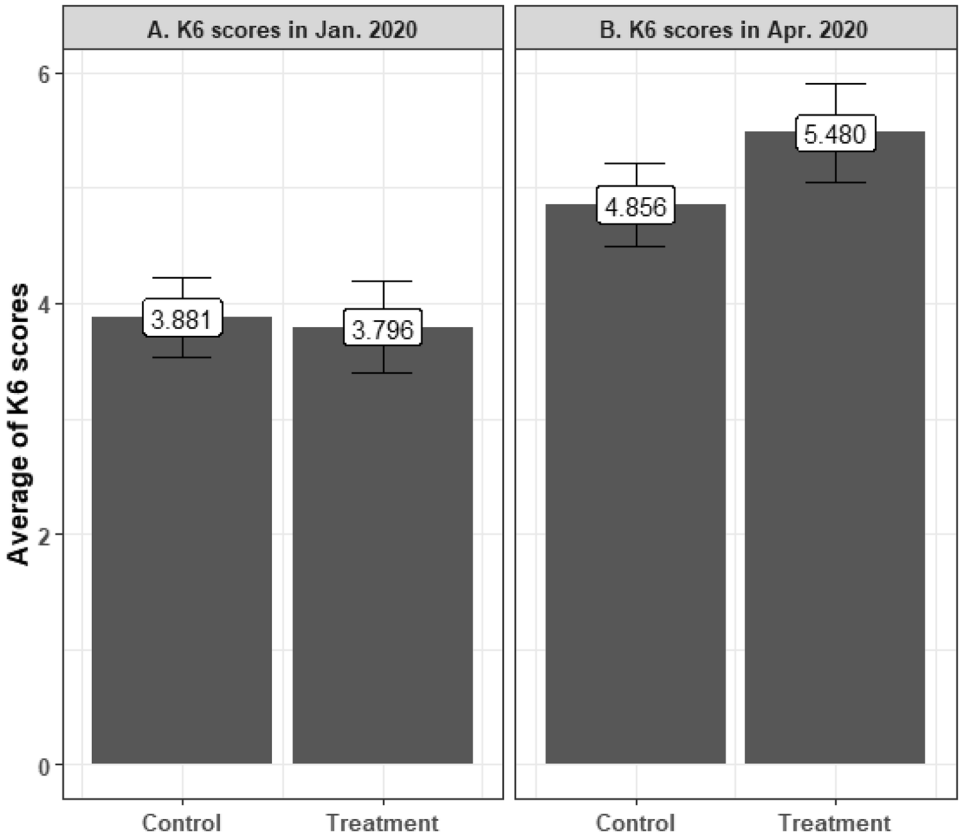

Fig. 3 Difference in Kessler Psychological Distress Scale scores between the treatment and control groups

child's age, we created dummy variables for four categories: 0–6, 7–12, 13–15, and ≥16.[14] For the number of household members, we created dummy variables indicating that there were 1–3 members, 4–6 members, and ≥7 members. For caregiving for older adults, we used a dummy variable that took the value of 1 when there was at least one hour of caregiving in a week. We also included dummy variables for living with the respondent's or spouse's parents.[15] The household's location of residence consisted of three dummy variables: major metropolitan areas (MMAs), ordinance-designated cities (ODCs), and other core cities. MMAs were the largest metropolitan areas including Tokyo, Kanagawa, Chiba, Saitama, Aichi, Osaka, Hyogo, Kyoto, and Fukuoka prefectures. ODCs were large cities with a population greater than 500,000, whereas other core cities were smaller than ODCs but had a population greater than 200,000.

Time-varying covariates included household income, employment, health status, and residential mobility. Household income was the logarithmic value of monthly household income. Employment was a dummy variable that took the value of 1 if the respondent was employed in the previous month and 0 if not. We also included the spouse's employment status. To control for parents' health shock, subjective health status was used. This variable took a value from 1 to 5, with larger values indicating poorer health.[16] Residential mobility was a dummy variable that took the value of 1 if households had moved between January and April.

As these variables took different values in January and April, Table 2 shows the means and standard deviations separately for the two time points. For some variables, we controlled for the time-varying values and pretreatment values in our regression models. For example, we include both time-varying employment status (i.e., employment status in January and April) and pre-treatment status (i.e., employment status in January) simultaneously. This means that our model controls for the effect of changes in employment status during the pandemic as well as the pretreatment baseline of the same variable before the pandemic. We think that controlling for both time-varying and pretreatment employment status is important in our context. The changes in employment status as measured by time-varying values are

[14] If there were two or more children in the household, we used the age of the first-born child for this variable.

[15] We did not include respondents' marital status, because there were no single-parent households in our sample.

[16] Several variables regarding respondents' health status were surveyed in the JHPS; we used subjective health status, because this was also asked in the JHPS-COVID19.

Table 2 Descriptive statistics

Variable	Mean	SD	Max	Min
A. Key variables				
Outcome variable				
K6 score (January)	3.849	4.178	20	0
K6 score (April)	5.093	4.465	18	0
Treatment variable				
Daycare facility closure defined by Table 1	0.380	0.486	1	0
B. Pretreatment covariates				
Age of respondent (years)				
≤29 (=1, reference)	0.070	0.255	1	0
30–34 (=1)	0.306	0.462	1	0
35–39 (=1)	0.357	0.480	1	0
≥40 (=1)	0.267	0.443	1	0
Female (=1)	0.539	0.499	1	0
College graduate (=1)	0.516	0.501	1	0
Employment status				
Dual earner: regular employment (=1)	0.310	0.463	1	0
Dual earner: regular and non-regular employment (=1)	0.310	0.463	1	0
Dual earner: non-regular employment (=1)	0.043	0.202	1	0
Single earner (=1, reference)	0.337	0.474	1	0
Age of first-born children (years)				
0–6 (=1, reference)	0.636	0.482	1	0
7–12 (=1)	0.291	0.455	1	0
13–15 (=1)	0.043	0.202	1	0
≥16 (=1)	0.031	0.174	1	0
Number of household members				
1–3 (=1, reference)	0.341	0.475	1	0
4–6 (=1)	0.593	0.492	1	0
≥7 (=1)	0.066	0.249	1	0
Number of parents living with the respondent	0.054	0.301	2	0
Number of parents of spouse living with the respondent	0.070	0.334	2	0
Long-term care (=1)	0.027	0.163	1	0
Major metropolitan areas (=1)	0.643	0.480	1	0
Ordinance-designated cities (=1)	0.376	0.485	1	0
Core cities (=1)	0.566	0.497	1	0
	January		April	
	Mean	SD	Mean	SD
C. Time-varying covariates				
Household income (10,000 yen per month)	48.779	68.530	47.888	64.581
Employment (=1)	0.725	0.447	0.690	0.463
Employment of spouse (=1)	0.775	0.418	0.752	0.433
Health status	2.147	0.861	1.721	0.860
Moving (=1)	0.000	0.000	0.031	0.174
D. COVID-19-related covariates				
New positive per 1000 persons in each prefecture	0.000	0.000	0.110	0.097
Stay-home rate in each prefecture	0.000	0.000	0.399	0.085
Polymerase chain reaction-tested or wanted (=1)	0.000	0.000	0.085	0.280
Closed elementary and junior high school (=1)	0.000	0.000	0.190	0.393

Note: Number of households is 258 for both January and April. (=1) indicates the dummy variable

important, as the pandemic inevitably adversely impacted the employment of at least some respondents. Pretreatment employment status in January is also important, because the pandemic could have a differential impact based on the baseline employment status. In the prior literature, non-regular workers were more susceptible to being impacted by the COVID-19 pandemic because of the difficulty of working from home (Fukai et al., 2022; Kikuchi et al., 2021). In addition, although employment and household income are highly correlated and there may be a multicollinearity problem, household income was included to capture income sources other than labor income.

Finally, the following COVID-19-related covariates were included to control for stress from the environment. The number of new positive cases was drawn from official statistics reported by each prefecture.[17] This was included as the number of new positive cases per 1000 persons. Although Japanese policy did not have mandatory movement restrictions during our sample period, many people voluntarily stayed at home, especially in places with a severe infection situation. Using mobile phone location data, the stay-home rate measured the proportion of people staying in their residential areas (i.e., within a 500 m square grid of their residence). The proportion was normalized by taking the difference between post- and pre-pandemic values. We used the prefecture-level aggregate data made available by Mizuno Laboratory.[18] In addition, the polymerase chain reaction (PCR)-tested or wanted dummy was a variable indicating that a respondent had received or wanted to receive a PCR test. This variable was taken from the JHPS-COVID19. We also created a dummy variable that took the value of 1 if there were children between the ages of 7 and 15 years in the respondent's family. As all elementary and junior high schools were closed by a government order during the first state of emergency, this variable indicated whether the respondent was affected by the school closures. These variables were included to collectively control for the external health-related shocks of the COVID-19 pandemic, which could differ across regions and between households.

[17] These numbers were based on the "Map of New Coronavirus Infections by Prefecture—Dashboard & Map of COVID-19 Japan Case" provided by the J.A.G JAPAN Corp.

[18] See Mizuno et al. (2021) for a detailed description of this variable. Figures A2 and A3 in the supplementary material show the stay-home rate during the sample period.

Method of Analysis

Identification Strategy

We employed the DID method to identify the impact of daycare closures on parental distress. A conventional DID analysis requires the parallel trends assumption, meaning that the treatment group would have trended the same as the control group if no treatment had occurred. The parallel trends assumption is critical in our context, as the pandemic obviously had an adverse impact on stress levels even without daycare closures. The change in treated parents' stress levels before and after the pandemic was therefore likely to overestimate the impact of daycare closures.

To assess the validity of the parallel trends assumption, researchers often test parallel trends in pretreatment periods. Figure 4 compares the average K6 scores of the treatment and control groups over time, where pretreatment K6 scores are from the JHPS 2019 and 2020. While the pretreatment trends in the average K6 scores differ slightly between the treatment and control groups, the confidence intervals (shown by whiskers) largely overlap in both 2019 and 2020. Hence, the K6 scores appear to have parallel trends in the pretreatment periods. Figure 4 also shows that the average K6 scores substantially increased after the pandemic, and this increase was larger for the treated parents than the controls, although the confidence intervals overlap in April 2020.

Figure 4 gives us some confidence that the parallel trends assumption holds in our case. However, there are several concerns regarding the validity of our comparison in Fig. 4. First, we note that treatment status can be correlated with

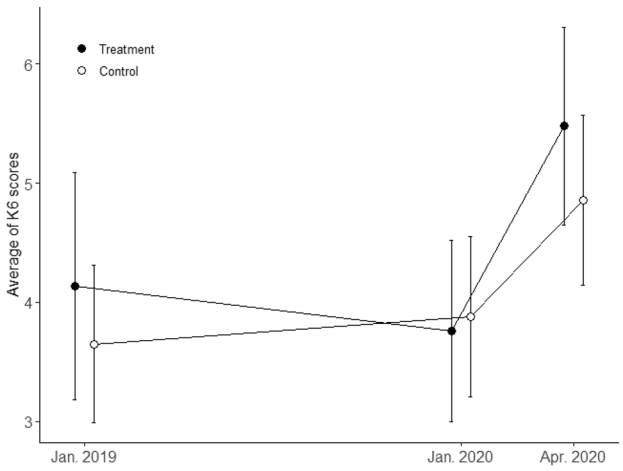

Fig. 4 Validation of the parallel trends assumption by the average of the Kessler Psychological Distress Scale scores. Notes: the whiskers above and below each point indicate the confidence interval

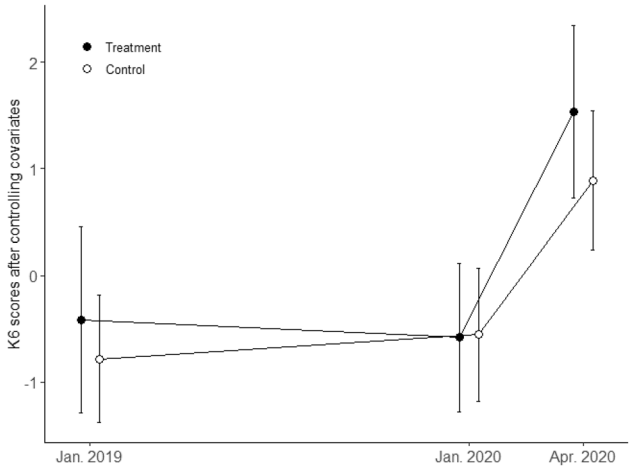

Fig. 5 Validation of the parallel trends assumption after controlling for covariates excluding COVID-19-related covariates. Notes: the points are the regression residuals, which do not include the treatment variable and COVID-19-related covariates, and include the pretreatment and time-varying covariates

some household/individual characteristics. For example, treated parents were more likely to live in metropolitan areas, have a college degree, and be dual earners.[19] If these characteristics affected pretreatment trends, the raw comparison shown in Fig. 4 may be inappropriate. To address this issue, we calculated the K6 scores conditional on observed covariates and compared the averages over time. Figure 5 provides the residualized version of Fig. 4 after regressing the observed K6 scores on pretreatment and time-varying covariates.[20] As a result, we did not find any differential pre-trends even with covariate adjustment.

Second, the general impact of the pandemic may have differed across the treatment and control groups, violating the parallel trends assumption. We know that the pandemic had a huge impact on a wide range of economic activities and daily life, differing substantially across locations or between households. For example, the adverse impact of the pandemic on employment and earnings tended to be greater for female, low-skilled, or part-time workers (Fukai et al., 2021; Kikuchi et al., 2021). Health-related risks of the pandemic could have been greater for people with poorer health beforehand. All these factors served as a time-varying confounder that could have biased the conventional DID estimate. One way to address this issue is to extend the conventional DID setting, where the parallel trends assumption holds only when conditional on observed covariates. As discussed in the next section, our baseline model allowed for differential trends depending on key pretreatment covariates such as age, gender, education, and employment status.

Third, the endogeneity of each facility's daycare closure decision could also be an issue. Daycare closures were based on the voluntary decision of each facility. Although some local governments requested closures during the first state of emergency, actual implementation was left to the discretion of each facility. In the following analysis, we assumed that daycare closure decisions were random conditional on the local COVID-19 situation. Specifically, we controlled for covariates reflecting the local prevalence of COVID-19, such as the number of newly reported COVID-19 cases and stay-home rate in each prefecture.

Finally, the selection of daycare facilities by household may not have been random, leading to pretreatment or self-selection bias. During the state of emergency, kindergartens were more likely to be closed than nursery schools. As a result, households' selection into different types of institutions leads to differential treatment assignments. To address this issue, we also estimated the doubly-robust DID models (Sant'Anna & Zhao, 2020) as a robustness check. These alternative models yielded similar results as our baseline model, implying that pretreatment bias was not substantial. These results are reported in the "Tables A2 and A4 in the supplementary material."

DID Approach and its Extensions

Based on the identification strategies discussed in the previous section, the panel DID model is as follows:

$$Y_{it} = \alpha T_t + \tau^{did} D_{it} + \theta' X_i + \eta' T_t X_i + \beta' X_{it} + \mu_i + \varepsilon_{it}, \qquad (1)$$

where i and t indexes household and time, respectively. Y_{it} is the K6 scores for parents with children. D_{it} is the treatment variable indicating respondents whose children's daycare facilities were closed. X_i is the pretreatment covariates and X_{it} the time-varying and COVID-19-related covariates. T_t is a post-treatment dummy variable (i.e., April 2020), and $T_t X_i$ an interaction term between the post-treatment dummy variable and pretreatment covariates. ε_{it} is the error term.

As discussed in the previous section, Eq. (1) identifies the impact of daycare closures on parental distress under several underlying assumptions. First, we controlled for time-varying covariates (X_{it}) including household income, employment, and health status. Introducing these covariates is particularly important as we sought to control for the pandemic's general impact on employment, income, and parental health status. Second, we introduced time-by-covariate interactions ($T_t X_i$). As a result, Eq. (1) allows for differential time trends depending on key pretreatment covariates such as age, gender, education, and employment

[19] See Figure A5 for details.

[20] In this regression adjustment, we did not use COVID-19-related covariates because they have variations only in the post-treatment period.

Table 3 Estimation results of treatment effects

					Multicollinearity tests	
					Excluded employment status in pretreatment covariates	Excluded employment dummy and income in time-varying covariates
	1	2	3	4	5	6
Treatment variable (=1)	0.709 (0.569)	0.993 (0.613)	1.006 (0.616)	1.202† (0.630)	1.175† (0.629)	1.328* (0.618)
Control variable						
Pretreatment covariates	No	Yes	Yes	Yes	Yes	Yes
Time-varying covariates	No	No	Yes	Yes	Yes	Yes
COVID-19 related covariates	No	No	No	Yes	Yes	Yes
Number of observations	516	516	516	516	516	516
Number of households	258	258	258	258	258	258

The treatment variable indicates the daycare facility closure defined by Table 1. Numbers in parentheses are robust standard errors. The multicollinearity test is an estimation that excludes either the employment status of the pretreatment variables or the income and employment dummy of the time-varying variables, which are likely to be highly correlated

Significance level: †$p < 0.1$, *$p < 0.05$

status; therefore, our identification required the parallel trends assumption conditional on these observed pretreatment covariates. Finally, we introduced COVID-19-related covariates, included in X_{it}. This further allowed us to control for the general impact of the COVID-19 pandemic. Based on these underlying assumptions, τ^{did} can be interpreted as an estimate of average treatment effects on the treated (ATT).

ATT of daycare closures on the K6 may differ depending on individual characteristics such as gender, age, age of children, and household income. Yokoyama and Takaku (2020) reported that daycare closures caused an immediate deterioration in mothers' psychological stress. To test the heterogeneous effects, we estimated the DID model with interaction terms.

$$\begin{aligned} Y_{it} =& \alpha_1 T_t + \alpha_2 (T_t \cdot H_i) + \tau_1^{did} D_{it} + \tau_2^{did} (D_{it} \cdot H_i) \\ &+ \eta' T_t X_i + \beta' X_{it} + \mu_i + \epsilon_{it} \end{aligned} \tag{2}$$

where H_i is a vector of household characteristics such as gender, employment status, child's age, and location of residence. Equation (2) allowed us to test whether ATT differed across population subgroups. The estimated ATT of the reference group is τ_1^{did} and the estimates for the other groups are $\tau_1^{did} + \tau_2^{did}$, where standard errors are calculated based on the delta method.

Results

Baseline Results

We estimated Eq. (1) to determine whether the closure of daycare facilities during the first state of emergency increased parental stress. Table 3 shows the estimation results. The result in Column 1, which does not include any covariates, shows that the treatment effect was positive but not statistically significant. The result in Column 2, controlling for the pretreatment covariates, and that in Column 3, additionally controlling for time-varying covariates, do not demonstrate significant results. However, after further including COVID-19-related covariates to control for the differential impact of the pandemic across regions and between households, the estimate in Column 4 became positive and significant at the 10% level. On average, daycare closures increased the K6 scores for treated parents by 1.202 points.[21] This means that the K6 scores were about 23.6% higher than the average of the April K6 scores in Table 2.

It is considered that employment and household income can have a high correlation and that including both variables in an equation can produce the problem of multicollinearity.[22] In Column 5, we excluded employment status from the pretreatment variables, and the estimate was significant at 1.175, smaller than the 1.202 in Column 4. In Column 6, we further excluded employment dummies and household income from the time-varying variables. In the results, the estimate of 1.328 was statistically significant and larger than the 1.202 in Column 4. The results above indicate that there were few multicollinearity problems in the estimation results of Column 4, which included all covariates.

[21] This estimate does not differ from the one that accounts for pretreatment bias (selection bias), suggesting that there is no effect of pretreatment bias (see supplementary material).

[22] We acknowledge an anonymous reviewer who pointed out this problem.

Extensions and Robustness Checks

We performed the following three estimations to check the robustness of the baseline result. First, we excluded households that did not use daycare services before the pandemic and those that voluntarily missed daycare during the pandemic. We then estimated the same model for this restricted sample. Second, we estimated Eq. (2) and its extension to test the heterogeneous treatment effects. Finally, binomial models were estimated, where the dependent variable was a dummy variable defined based on the clinical cutoff value of the K6.

Alternative Treatment Variable

In the baseline result, we focused on all households with preschool children. In this case, the control group included households that refrained from using daycare facilities during the first state of emergency and those that did not use daycare facilities before the state of emergency. Here, as a robustness check, we estimated the model based on the subsample excluding respondents whose children "Never attended daycare facilities" (Option 1 in Table 1) and those who "Refrained from going to daycare facilities even though they were open" (Option 3 in Table 1) from the treatment group. The children of those respondents did not go to daycare facilities during the pandemic. However, those households could have had different features from those whose children did not go to daycare owing to closure. For example, as Fig. 6 shows, the average number of children in the former group was 1.5 and the average of the latter group was 1.7. These averages were lower than those of other groups. Those households could be highly sensitive to the COVID-19 pandemic. Thus, we estimated the treatment effects without these households for the robustness checks.

Therefore, we employed the sample of households that were using daycare facilities in January. Table 4 defines the alternative treatment indicators of T1 and T2. In T1, the option "Never attended daycare facilities" was deleted from the sample. In T2, in addition to T1, the option "Refrained from going to daycare facilities even though they were open" was excluded from the sample. In the redefined treatment variables, households that could not use daycare facilities owing to closure were assigned the value of 1, and all other households were assigned the value of 0.

The estimation results with the alternative treatment variables are shown in Table 5. Column 1 shows the estimation results with the alternative treatment indicator of T1 in Table 4. Excluding households that did not use daycare facilities before the pandemic, the average treatment effect was 1.546, which was somewhat larger than our baseline estimate of 1.202 in Column 4 in Table 3. Column 2 shows the result when we further exclude households that refrained from using daycare facilities. We obtained the estimate of 3.374 points, more than double the estimate in Column 1. This means that our baseline results may have been substantially underestimated by including households that voluntarily missed daycare into our sample.

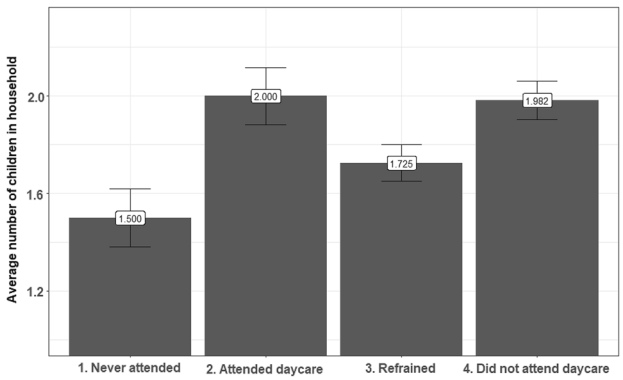

Fig. 6 Average numbers of children in households with preschool children

Heterogeneous Effects

Previous study (Yokoyama & Takaku, 2021) mentioned that mothers suffered from the school closures under the state emergency. Thus, we conducted our analysis reflecting gender and employment status differences. Our sample size was limited, and the analysis based on the subsample did not give clear results. Therefore, we estimated the DID model with interaction terms to examine the heterogeneity of respondents as Eq. (2).

Table 6 shows the estimation results of the treatment variables with an interaction term of a female indicator for H_i in Eq. (2) and employment status indicator for H_i in the same equation. Columns 1 and 2 of the heterogeneous effects of gender show that the estimate of the treatment effect for females was significant. The coefficient of about 2.2 was almost twice as large as that of 1.2 in Column 4 in Table 3. Columns 3–6 are the treatment effects of parents' employment status. These show that the results were positive and statistically significant only for households of non-regular employed dual earners. The coefficient was about 6.7, which indicates that the K6 scores deteriorated greatly.[23]

Table 7 depicts the estimation results by children's age. Panel A shows the result of the treatment effects of the children's age dummy of under 3 years and over 4 years. A significant result was found regarding the treatment effects for children aged over 4 years. Panel B shows the results of the

[23] We also estimated heterogeneity with respect to parental age, but no significant results were obtained.

Table 4 Alternative definitions of the treatment variable for the robustness check: Excluding self-restraint households

	Option	Alternative treatments indicators					
		n	%	T1	n	%	T2
1	Never attended daycare facilities	–	–	–	–	–	–
2	Attended daycare facilities without experiencing any closures	40	17	0	40	26	0
3	Refrained from going to daycare facilities even though they were open	83	35	0	–	–	–
4	Did not attend daycare facilities owing to closure in April	115	48	1	115	74	1
	Total	238	100		155	100	

This table shows the alternative definition of the treatment variable in April 2020 surveyed by the JHPS-COVID19 Supplement

Table 5 Robustness check: estimation results of treatment effects with alternative treatment definitions from Table 4

	Treatment T1 1	Treatment T2 2
Treatment variable (=1)	1.546* (0.768)	3.374** (1.015)
Control variables		
Pretreatment covariates	Yes	Yes
Time-varying covariates	Yes	Yes
COVID-19 related covariates	Yes	Yes
Number of observations	404	264
Number of households	202	132

The treatment variable indicates the daycare facility closure defined by Table 4. Numbers in parentheses are robust standard errors

Significance level: $*p < 0.05$, $**p < 0.01$

treatment effects of the children's age dummies from ages 0 to 2 years, 3 to 4 years, and 5 to 6 years. In this case, significant results were found for 5–6-year-olds. Thus, the older the child, the worse the parents' distress owing to daycare closures.[24]

Treatment Option Effects: Closure Effects and COVID-19 Infection Risk

The treatment variable of Eq. (1) was replaced by a group of dummy variables of treatment options in Table 1: "Never attended daycare facilities," "Refrained from attending daycare facilities," "Did not attend daycare facilities owing to closure"; the reference group was "Attended daycare facilities." Column 1 in Table 8 presents the estimation result that corresponds to Eq. (1) and shows that compared to the reference group of households that used daycare facilities, respondents whose children did not attend daycare facilities in any form experienced increased psychological distress. Among these options, groups that did not attend daycare facilities owing to closure experienced the highest increase in K6 scores, but groups of respondents who refrained from going to daycare facilities experienced the least increase in K6 scores.

Equation (2), wherein the treatment variable was replaced by group dummies of treatment options, was also estimated. Columns 2 and 3 in Table 8 show the estimation results of the coefficients of interaction terms with the gender indicator, meaning that the K6 scores of female respondents whose children did not attend daycare facilities increased.

Columns 4 and 5 in Table 8 show the estimation results of the coefficients of interaction terms with the indicator of MMAs and other areas where respondents lived. Although the coefficients of the treatment options for non-MMAs were significantly positively different from 0, the coefficients of treatment options for MMAs were not significantly different from 0. In sum, in households in urban areas such as MMAs, the effect of closed daycare facilities on parental K6 scores could not be confirmed.

Clinical Cutoff Models

In previous estimates, the K6 was scored from 0 to 24 points, but the clinical impact of a 1-point increase in K6 score from 0 to 1 is very different from an increase from 9 to 10. In epidemiology, wherein the K6 is often used, its scores are divided by specific values and used as a dummy variable (Kusama et al., 2019). We followed Yokoyama and Takaku (2021) and created a "moderate" distress dummy, which takes a score of 1 if the K6 score is ≥5 points, and a "severe" distress dummy, which takes a score of 1 if the K6 score is ≥10 points. These two dummy variables are used as outcome variables in clinical cutoff models.

Table 9 shows the estimation results of the baseline model based on all households with preschool children, where Column 1 depicts the estimation results of the model of the moderate distress level indicator, which takes 1 if the K6 score is ≥5 points. This estimate was positive and significant at the 10% level. Considering that the mean value of the K6 score for the treatment group in January was 3.796 (Fig. 3) and the effect of daycare facility closure was 1.202 (Table 3), it is clear that daycare facility closure caused a moderate

[24] We estimated the children in each age group, but could not confirm the significance of the 0–5 age group. We also estimated the effect on the number of children, but could not identify a significant effect.

Table 6 Estimation results on the K6 scale by gender and employment status

	Gender		Employment status of parents			
	Male	Female	Single earner	Dual earner		
				Non-regular	Regular and non-regular	Regular
	1	2	3	4	5	6
Treatment variable (=1)	0.134 (0.867)	2.225** (0.800)	1.291 (1.013)	6.663** (1.390)	0.940 (1.077)	0.551 (1.211)
Control variable						
Pretreatment covariates	Yes				Yes	
Time-varying covariates	Yes				Yes	
COVID-19-related variables	Yes				Yes	
Number observed	516				516	
Number of households	258				258	

The treatment variable indicates the daycare facility closure defined by Table 1. Numbers in parentheses are robust standard errors

Significance level: $^{**}p < 0.01$

Table 7 Estimation results on the K6 scale by child's age

A. Interaction terms with child's age dummy: under 3 years (reference is 4–6 years)			
	Under 3 years		Over 4 years
	1		2
Treatment variable (=1)	0.512 (0.782)		1.770† (0.928)
Number of observations	494		
Number of households	247		
B. Interaction terms with child's age dummies: every two years (reference is 5–6 years)			
	0–2 years	3–4 years	5–6 years
	1	2	3
Treatment variable (=1)	−0.039 (1.319)	1.470 (1.080)	1.793† (1.013)
Number of observations	494		
Number of households	247		

The treatment variable indicates the daycare facility closure defined by Table 1. Numbers in parentheses are robust standard errors

Significance level: $\dagger p < 0.1$

Table 8 Extension estimation results: Heterogeneous treatment effects

	Base	Gender		Major Metropolitan Area (MMA)	
		Male	Female	Not MMA	MMA
	1	2	3	4	5
Treatment options (reference is "Attended daycare facilities")					
Never attended daycare facilities (=1)	2.553* (1.058)	0.875 (1.525)	3.854** (1.231)	4.685** (1.541)	0.893 (1.325)
Refrained from going to daycare facilities (=1)	1.815† (0.950)	1.402 (1.431)	2.194* (1.065)	3.939** (1.443)	0.112 (1.168)
Did not attend daycare facilities owing to closure (=1)	2.915** (0.941)	1.092 (1.340)	4.551** (1.159)	4.276** (1.469)	1.667 (1.114)
Number of observations	516	516		516	
Number of households	258	258		258	

Parentheses are robust standard errors

Significance level: $\dagger p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$

Table 9 Robustness checks: estimation results of clinical cutoff models

	Moderate level (K6 ≥ 5)	Severe level (K6 ≥ 10)
	1	2
Treatment variable (=1)	0.158† (0.081)	0.079 (0.056)
Control variable		
Pretreatment covariates	Yes	Yes
Time-varying covariates	Yes	Yes
COVID-19-related covariates	Yes	Yes
Number of observations	516	516
Number of households	258	258

Numbers in parentheses are robust standard errors. Linear probability models are estimated

Significance level: †$p < 0.1$

worsening of stress. Column 2 shows the estimation results of the model for severe psychological distress where the K6 score is ≥10 points as an outcome, but statistical significance was not confirmed.

Discussion and Conclusion

The purpose of this study was to quantify the effect of the closure of daycare facilities on parents' distress during the COVID-19 pandemic in Japan. For the analysis, we used the JHPS (main survey) conducted before the pandemic and JHPS-COVID19 conducted during the pandemic. DID models were estimated to eliminate the effects of the common shocks of COVID-19.

Our empirical results showed that the closure of daycare facilities during the first state of emergency significantly increased the stress of parents with preschool children. The impact was particularly large for mothers, consistent with the findings of Yokoyama and Takaku (2021), Huebener et al. (2021), and Wu et al. (2020). Our results suggest that daycare closures affected parents' distress differently, widening the gap between mothers and fathers. Previous studies also showed that during the pandemic, mothers tended to work from home to care for their children (Yamamura & Tsustsui, 2021b) and their childcare burden disproportionately increased compared to that of fathers (Nomura et al., 2022).[25] Thus, the closure of daycare facilities in Japan may have resulted in a significant increase in mothers' stress, because the burden of childcare was concentrated on them.

We also found that daycare facility closures increased stress among households with non-regular dual earners. Previous studies showed that non-regular workers were affected more by the COVID-19 pandemic because work-from-home options were limited (Fukai et al., 2021; Kikuchi et al., 2021). Being able to work from home was very important for dual-earner households, as the closure of daycare facilities required that one parent stayed home during the day. However, in this situation, if both parents in a non-regular dual-earner household are unable to work from home, one must reduce their working time or give up their job. Overall, our empirical results indicated that the negative impact of daycare closures on parental stress was primarily due to the increased burden of childcare.

Another potential pathway through which daycare closures affected parental distress is that it may have reduced parents' anxiety toward infection by keeping their children at home. In the early phase of the pandemic, it was impossible for parents to properly assess the risk of infection for their children and themselves. Our empirical results showed that daycare closures did not significantly affect parents living in MMAs. Given the high risk of infection in these areas, daycare closures could reduce parents' anxiety regarding infection, offsetting the adverse impact of increased childcare burden. In addition, daycare closures did not significantly affect parents of younger children (especially those aged under 2 years). Since small children were thought to be vulnerable to COVID-19 infection, keeping them at home during the daycare closures could have reduced parents' anxiety regarding infection, thereby offsetting the adverse impact due to increased childcare burden.

Our empirical findings highlight the following two policy implications. First, emergency childcare provision could have differential gains depending on households' characteristics and the childcare situation. As mentioned, our results indicated that the negative effects of daycare closures were greater for mothers, non-regular workers, and parents with relatively older children. Thus, in an emergency such as the COVID-19 pandemic, the uniform suspension of childcare services regardless of households' childcare needs could be costly.

Second, the cost and benefit of emergency childcare provision also depends on local conditions. In Japan, the state of emergency was first issued in the MMAs, considering the local infection situation, and later expanded to the rest of the country. In addition, daycare closures under the state of emergency were less enforceable, unlike the lockdowns imposed in other countries. Although some local governments requested closures during the state of emergency, actual implementation was left to the discretion of each facility. Our empirical results, which showed no

[25] In contrast, several previous studies pointed out that fathers' participation in childcare was facilitated during the lockdown in Italy (Del Boca et al., 2020) and in the first state of emergency in Japan (Nomura et al., 2022). Despite an increase in fathers' participation in childcare, Nomura et al. (2022) also confirmed that mothers were more likely to feel overburdened regarding childcare than fathers.

significant increase in parental stress due to daycare closures in MMAs, suggest that a risk-based, local closure policy could have been effective in terms of parental stress during the emergency.

Finally, we add notes for future studies. First, we focused on April 2020, identifying only the short-term effects of the closure of daycare facilities. Thus, the long-term effects have not been explored. Second, the length of the daycare closure period and quality of daycare services are also important factors affecting parental stress, although these were not analyzed in this study. Some daycare facilities were closed for a long period, and others for a much shorter time. In addition, the pandemic may also have affected the quality of care provided. Lastly, from a broader perspective, the COVID-19 pandemic may have had a significant impact on children. In this study, we were unable to analyze the impact of daycare closures on children due to data limitations. Thus, gathering such information and analyzing the association between daycare closures and child outcomes are topics for future study.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10834-023-09929-5.

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Data Availability The original data used for this study are available from the Panel Data Research Center at Keio University upon application for research purposes. Replication data are available from the authors upon reasonable request and with permission of the Panel Data Research Center at Keio University.

Declarations

Conflict of interest All authors declare that they have no conflict of interest to declare.

Ethical Approval As a secondary analysis of the data provided by the Panel Data Research Center at Keio University, ethical approval was not required for this study.

Informed Consent Informed consent for participation in the original surveys (JHPS and JHPS-COVID 19) was obtained in accordance with requirements of the Institutional Review Board of Keio University.

References

Ahnert, L., & Lamb, M. E. (2003). Shared care: Establishing a balance between home and child care settings. *Child Development, 74*(4), 1044–1049. https://doi.org/10.1111/1467-8624.00587

Arons, A. (2022). An unintended abolition: Family regulation during the COVID-19 crisis. *Columbia Journal of Race and Law Forum*, *12*(1), 1–28. https://doi.org/10.52214/cjrl.v12i1.9149

Baker, M., Gruber, J., & Milligan, K. (2008). Universal child care, maternal labor supply, and family well-being. *Journal of Political Economy, 116*(4), 709–745. https://doi.org/10.1086/591908

Belsky, J., Vandell, D. L., Burchinal, M., Clarke-Stewart, K. A., McCartney, K., Owen, M. T., & The NICHD Early Child Care Research Network. (2007). Are there long-term effects of early child care? *Child Development*, *78*, 681–701. https://doi.org/10.1111/j.1467-8624.2007.01021.x

Brown, S. M., Doom, J. R., Lechuga-Peña, S., Watamura, S. E., & Koppels, T. (2020). Stress and parenting during the global COVID-19 pandemic. *Child Abuse & Neglect*, *110*(2), 104699. https://doi.org/10.1016/j.chiabu.2020.104699

Del Boca, D., Oggero, N., Progeta, P., & Rossi, M. (2020). Women's and men's work, housework and childcare, before and during COVID-19. *Review of Economics of the Household, 18*, 1001–1017. https://doi.org/10.1007/s11150-020-09502-1

Fukai, T., Ichimura, H., & Kawata, K. (2021). Describing the impacts of COVID-19 on the labor market in Japan until June 2020. *The Japanese Economic Review, 72*(3), 439–470.

Griffith, A. K. (2022). Parental burnout and child maltreatment during the COVID-19 pandemic. *Journal of Family Violence, 37*, 725–731. https://doi.org/10.1007/s10896-020-00172-2

Gunnar, M. R., & Donzella, B. (2002). Social regulation of the cortisol levels in early human development. *Psychoneuroendocrinology, 27*(1), 199–220. https://doi.org/10.1016/S0306-4530(01)00045-2

Gunnar, M. R., Kryzer, E., Van Ryzin, M. J., & Phillips, D. A. (2010). The rise in cortisol in family day care: Associations with aspects of care quality, child behavior, and child sex. *Child Development, 81*(3), 851–869. https://doi.org/10.1111/j.1467-8624.2010.01438.x

Hart, E. R., Vandell, D. L., Whitaker, A. A., & Watts, T. W. (2023). Child care and family processes: Bi-directional relations between child care quality, home environments, and maternal depression. *Child Development, 94*(1), e1–e17. https://doi.org/10.1111/cdev.13858

Heckman, J., Pinto, R., & Savelyev, P. (2013). Understanding the mechanisms through which an influential early childhood program boosted adult outcomes. *American Economic Review, 103*(6), 2052–2086. https://doi.org/10.1257/aer.103.6.2052

Huebener, M., Waights, S., Spiess, C. K., Siegel, N. A., & Wagner, G. G. (2021). Parental well-being in times of COVID-19 in Germany. *Review of Economics of the Household, 19*(1), 1–32. https://doi.org/10.1007/s11150-020-09529-4

Johnson, A. D., Finch, J. E., & Phillips, D. A. (2019). Associations between publicly funded preschool and low-income children's kindergarten readiness: The moderating role of child temperament. *Developmental Psychology, 55*(3), 623–636. https://doi.org/10.1037/dev0000651

Kessler, R. C., Andrews, G., Colpe, L. J., Hiripi, E., Mroczek, D. K., Normand, S. L., Walters, E. E., & Zaslavsky, A. M. (2002). Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological Medicine, 32*(6), 959–976. https://doi.org/10.1017/s0033291702006074

Kikuchi, S., Kitao, S., & Mikoshiba, M. (2021). Who suffers from the COVID-19 shocks? Labor market heterogeneity and welfare consequences in Japan. *Journal of the Japanese and International Economies*, *59*, 101117. https://doi.org/10.1016/j.jjie.2020.101117

Kusama, T., Aida, J., Sugiyama, K., Matsuyama, Y., Koyama, S., Sato, Y., Yamamoto, T., Igarashi, A., Tsuboya, T., & Osaka, K. (2019). Does the type of temporary housing make a difference in social participation and health for evacuees of the Great East Japan Earthquake and tsunami? A cross-sectional study. *Journal of Epidemiology, 29*(10), 391–398. https://doi.org/10.2188/jea.JE20180080

Lawson, M., Piel, M. H., & Simon, M. (2020). Child maltreatment during the COVID-19 pandemic: Consequences of parental job loss on psychological and physical abuse towards children. *Child Abuse & Neglect*, *110*(2), 104709. https://doi.org/10.1016/j.chiabu.2020.104709

Love, J. M., Harrison, L., Sagi-Schwartz, A., van IJzendoorn, M. H., Ross, C., Ungerer, J. A., Raikes, H., Brady-Smith, C., Boller, K., & Brooks-Gunn, J. (2003). Child care quality matters: How conclusions may vary with context. *Child Development*, *74*(4), 1021–1033. https://doi.org/10.1111/1467-8624.00584

McCartney, K., Burchinal, M., Clarke-Stewart, A., Bub, K. L., Owen, M. T., Belsky, J., & NICHD Early Child Care Research Network. (2010). Testing a series of causal propositions relating time in child care to children's externalizing behavior. *Developmental Psychology*, *46*(1), 1–17. https://doi.org/10.1037/a0017886

Ministry of Internal Affairs and Communications. (2022). *The Family Income and Expenditure Survey*. https://www.stat.go.jp/english/data/kakei/index.html

Mizuno, T., Ohnishi, T., & Watanabe, T. (2021). Visualizing social and behavior change due to the outbreak of COVID-19 using mobile phone location data. *New Generation Computing, 39*(3–4), 453–468. https://doi.org/10.1007/s00354-021-00139-x

Nomura, S., Endo, K., Omori, T., & Kisugi, N. (2022). Changes in parental involvement and perceptions in parents of young children during the COVID-19 pandemic: A cross-sectional observational study in Japan. *Global Health & Medicine*, *4*(3), 166–173. https://doi.org/10.35772/ghm.2022.01003

Ryser, V. A., & Heers, M. (2022). Early child-care arrangements and both parents' subjective well-being. *Journal of Child and Family Studies, 32*, 1002–1017. https://doi.org/10.1007/s10826-022-02432-9

Sant'Anna, P. H. C., & Zhao, J. (2020). Doubly robust difference-in-differences estimators. *Journal of Econometrics*, *219*(1), 101–122. https://doi.org/10.1016/j.jeconom.2020.06.003

Schüller, S., & Steinberg, H. S. (2022). Parents under stress: Evaluating emergency childcare policies during the first COVID-19 lockdown in Germany. *Labour Economics*, *78*, 102217. https://doi.org/10.1016/j.labeco.2022.102217

Sege, R., & Stephens, A. (2022). Child physical abuse did not increase during the pandemic. *JAMA Pediatrics, 176*(4), 338–340. https://doi.org/10.1001/jamapediatrics.2021.5476

Swedo, E., Idaikkadar, N., Leemis, R., Dias, T., Radhakrishnan, L., Stein, Z., Chen, M., Agathis, N., & Holland, K. (2020). Trends in US emergency department visits related to suspected or confirmed child abuse and neglect among children and adolescents aged <18 years before and during the COVID-19 pandemic—United States, January 2019–September 2020. *Morbidity and Mortality Weekly Report*, *69*(49), 1841–1847. https://doi.org/10.15585/mmwr.mm6949a1

Takaku, R., & Yokoyama, I. (2021). What the COVID-19 school closure left in its wake: Evidence from a regression discontinuity analysis in Japan. *Journal of Public Economics*, *195*, 104364. https://doi.org/10.1016/j.jpubeco.2020.104364

Vermeer, H. J., & van IJzendoorn, M. H. (2006). Children's elevated cortisol levels at daycare: A review and meta-analysis. *Early Childhood Research Quarterly*, *21*(3), 390–401. https://doi.org/10.1016/j.ecresq.2006.07.004

World Health Organization. (2020). *Global status report on preventing violence against children 2020*. Retrieved, July 28, 2023 from https://www.who.int/publications/i/item/9789240004191

Wu, M., Xu, W., Yao, Y., Zhang, L., Guo, L., Fan, J., & Chen, J. (2020). Mental health status of students' parents during COVID-19 pandemic and its influence factors. *General Psychiatry*, *33*(4), e100250. https://doi.org/10.1136/gpsych-2020-100250

Yamaguchi, S., Asai, Y., & Kambayashi, R. (2018). How does early childcare enrollment affect children, parents, and their interactions? *Labour Economics, 55*, 56–71. https://doi.org/10.1016/j.labeco.2018.08.006

Yamamura, E., & Tsustsui, Y. (2021a). School closures and mental health during the COVID-19 pandemic in Japan. *Journal of Population Economics, 34*(4), 1261–1298. https://doi.org/10.1007/s00148-021-00844-3

Yamamura, E., & Tsustsui, Y. (2021b). The impact of closing schools on working from home during the COVID-19 pandemic: Evidence using panel data from Japan. *Review of Economics of the Household, 19*(1), 41–60. https://doi.org/10.1007/s11150-020-09536-5

Yokoyama, I., & Takaku, R. (2021). How serious was it? The impact of preschool closure on mothers' psychological distress: Evidence from the first COVID-19 outbreak. https://ssrn.com/abstract=3756638