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ORIGINAL PAPER

Disruptions to early childhood preschool services during a pandemic: Evidence from India

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Abstract
Much less is known about the impacts of the COVID-19 pandemic on the provision of early childhood preschool services relative to research on school closures. We conducted surveys of more than 5000 early childhood service providers and leverage temporal and spatial variation in India's intensity of lockdowns to quantify disruptions to preschool services under the world's largest early childhood development program between areas with different strictness of lockdown measures. We document a 23 percentage point reduction in the provision of preschool services in red zone lockdown areas (strictest measures) relative to green zone lockdown areas (least strict measures). We find that pre-COVID measures of high worker locus of control and public service motivation offset the reduction in differential preschool service provision by 27–37%.

Keywords Early childhood development · Locus of control · Public service motivation · COVID-19 · Lockdowns · India

JEL Codes I25 · I15 · J13 · J18

1 Introduction

A large body of research documents the adverse effects of negative shocks during the early childhood years on later life human capital outcomes.[1] Thus, investments during the critical period between the ages of zero to five, when the developing brain is most

[1] See for example, Almond (2006); Currie and Neidell (2005); Almond et al. (2009); Shah and Steinberg (2017); Field et al. (2009); Buchmann et al. (2019); Shonkoff et al. (2012); Lu et al. (2016); Bleakley (2010), etc.

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plastic (Knudsen et al. 2006), are an important policy tool to improve the plight of low-income families worldwide (Cunha and Heckman 2007). However, the COVID-19 pandemic has disrupted the provision of early childhood preschool services in many countries, with the World Bank warning that the adverse impacts of the crisis on early childhood development could translate into lower learning levels impacting a whole generation (World Bank 2020).

A study of the factors mediating the provision of public services, and in particular, preschool services, in times of crisis and pandemics is of primary policy interest. While worker locus of control (the extent to which a person believes that work outcomes are determined by his or her actions relative to forces outside of their control) and public service motivation have been shown to impact labor supply and public service provision during non-pandemic periods, much less is known about their roles during crisis periods such as the COVID-19 pandemic (Perry and Wise 1990; Davis 2010; Cobb-Clark 2015).

Our study takes place within the context of the world's largest early childhood development program, the Integrated Child Development Services (ICDS) in India. India is also a unique setting for this study given variation in the severity of the measures imposed by the national and state governments, dividing areas into red, orange, and green zones, where red zones had the strictest measures and green zones had the least strict lockdowns. Using a combination of temporal and spatial variation in the intensity of lockdowns, we quantify differential impacts of the lockdown measures on the provision of early childhood preschool services in Odisha, India. We study the roles of worker locus of control and public service motivation in offsetting differential disruptions to preschool services between red and green zone lockdown areas.

We utilize two rounds of surveys for our study: the first was conducted in 2018, and the second in 2020–2021. From the first round of surveys in 2018, we utilize data on worker locus of control and public service motivation. In the second round of surveys in 2020–2021, we collected data on disruptions to the provision of core ICDS services during the COVID-19 pandemic and labor supply reallocation decisions that led to a crowding-out of time spent on preschool activities.

We find that ICDS workers in red zone sectors (strictest lockdown rules) were 23 percentage points less likely to provide preschool services relative to workers in green zones (least strict measures) in May 2020, relative to the first quarter of 2020. The negative differential impacts persist in August and November 2020, although the magnitudes are smaller: we estimate a 3.6 percentage point differential impact in August and 6.8 percentage point differential impact in November 2020. The negative differential impacts are, in part, due to a reallocation of labor supply towards COVID-19-related activities, which crowded out time spent on preschool and health services provision.

We study the roles played by two important mediators of service delivery: worker locus of control and public service motivation in the provision of preschool services. These variables were measured pre-COVID and are used to analyze heterogeneity in disruptions to service provision in May 2020, when impacts are most significant. Workers who have an above-median level of control over their work were 6.2 percent-

age points more likely to provide preschool services in red zones in May 2020 relative to green zones in February 2020. Workers with an above-median level of public service motivation were 8.5 percentage points more likely to provide preschool services. Although they do not completely offset the 23 percentage point differential reduction in provision of preschool services, higher control and public service motivation offset the decrease by 27% and 37%, respectively.

We contribute to a growing literature on the impacts of lockdowns and stay-at-home policies on the provision of early childhood preschool services during the COVID-19 pandemic. While prior research has focused on learning losses and disruptions relating to school closures affecting primary school-aged and older children, much less is known about the disruptions to early childhood services.[2] McCoy et al. (2021) use observational data collected prior to the pandemic to simulate the potential consequences of early childhood care and education (ECCE) service closures and estimate 19 billion person-days of ECCE instruction were lost across 196 countries. The projected developmental and learning losses were concentrated in low- and middle-income countries (LMICs). Hagihara et al. (2022) find differential impacts on social development among children aged 0–9 due to the closure of kindergartens in Japan. However, research on disruptions to the provision of preschool services in LMICs remains limited. While Nugroho et al. (2021) estimate that among LMICs, pre-primary students lost an average of 106 in-person instruction days in 2020, their analysis uses pre- versus post-lockdown comparisons for identification.

Our study is unique in three important ways. First, our identification strategy builds on the pre- versus post-lockdown temporal variation used in earlier studies, but in addition, we leverage federal and state government-mandated spatial variation in the intensity of lockdowns, as areas were classified into red, orange, and green zones with varying stringency of measures. This provides quasi-random variation in the lockdown intensity that we use to assess disruptions to early childhood services. Second, to the best of our knowledge, we provide the first quasi-experimental evidence on disruptions to *preschool services* in a LMIC setting. Since ICDS services include primary healthcare and preschool services, a study that only focuses on the broader ICDS might miss important disruptions to preschool services due to the differential lockdown measures. Third, and in a unique contribution to the best of our knowledge, we study the roles of worker locus of control and public service motivation in offsetting disruptions to service provision during the COVID-19 pandemic.

2 The Integrated Child Development Services

The ICDS was launched in 1975 by the Indian government to provide primary healthcare services to children 0–6 years of age and preschool education to children aged 3–6. Health services provided under the ICDS include prenatal care for pregnant mothers, in addition to immunizations, supplementary nutrition, health checkups, referral services, and provision of health information to children aged 6 and below. Today, the

[2] See Patrinos et al. (2022) for a recent review of 36 studies that focuses on children aged 5–18. Studies focusing on primary school children in India include recent work by Singh et al. (2022).

program is the largest early childhood development health and pre-school program in the world. By 2010, the program covered an estimated 40 million children each year. During the 2020–21 fiscal year, Indian government expenditure on the program was expected to be Rs. 205 billion (US $2.9 billion) (Financial Express 2020).

ICDS centers typically consist of a room for indoor activities and open space for outdoor activities. Centers are often run for 3–4 h a day, after which ICDS workers conduct home visits for about an hour. Each ICDS center is usually managed and run by one ICDS worker and, in some cases, with the assistance of a helper. ICDS workers teach preschool daily and conduct health check-ups, immunizations, and height and weight growth monitoring on a monthly basis.

Odisha provides a similar set of ICDS services in comparison with the rest of India.[3] For preschool services, Odisha saw the largest percentage increase in beneficiaries across all states in India between 2014 and 2019 (34%), in comparison to a 19% decrease across India (Kapur and Shukla 2020). We focus on preschool activities in our study, while also collecting data on the provision of four other core ICDS services: (i) height and weight monitoring, (ii) provision of vaccinations (non-COVID vaccinations such as for MMR), (iii) distribution of take-home rations, and (iv) home visits.

During the COVID-19 pandemic, ICDS workers and other frontline workers including Accredited Social Health Activists (ASHAs) and Auxiliary Nurse Midwives (ANMs) were tasked with a number of COVID-19-related tasks. These included community surveillance to identify suspect COVID-19 cases and contacts, mask distribution, monitoring home quarantine protocols, dissemination of information on critical COVID-19 preventive measures, curbing stigma and discrimination by addressing myths and misconceptions, and creating community support for battling the pandemic (Poddar and Mukherjee 2020). Such tasks reallocated time away from the provision of core ICDS services.

Furthermore, the closure of ICDS centers presented a number of challenges for the provision of core ICDS services. A NITI Aayog report notes that ICDS workers distributed essential food items to their beneficiaries in their homes while following COVID-19 protocols (Sarwal et al. 2022). In Odisha, ICDS workers provided pre-cooked ragi ladoo mix via home delivery in place of ragi ladoo as part of morning snacks usually provided in ICDS centers.

Importantly, the in-person delivery of preschool education was disrupted with the closure of ICDS centers. A number of ICDS workers digitized educational activities that were typically conducted at ICDS centers and shared them with parents to keep children engaged. The Government of Odisha also launched a state-wide online competition, "MoPratibha," a series of creative skill competitions for children of different age groups, to engage children in creative activities during the COVID-19 lockdowns (Poddar and Mukherjee 2020). In addition, the Odisha Department of Women and Child Development released "Ghare Ghare Arunima," a calendar-based list of activities for children to be implemented with the support of parents and grandparents. The activities included action songs, dance, painting, storytelling, and listening based

[3] More detail on ICDS services provided in Odisha are available here: https://wcd.odisha.gov.in/ICDS.

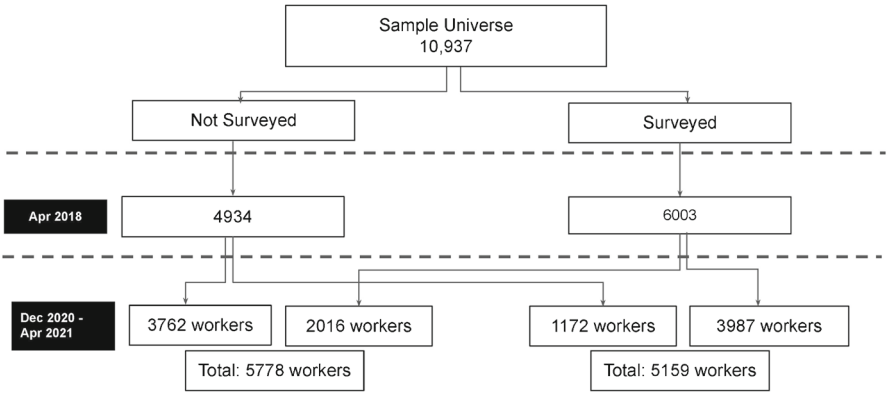

Fig. 1 Sampling and survey rounds. Notes: We use two rounds of data collected in (i) April 2018 and (ii) December 2020–April 2021. Of the universe of 10,937 workers in the three study districts, 6003 were surveyed in April 2018. Of these workers, 3987 were surveyed again in December 2020–April 2021, while an additional 1172 workers not surveyed in April 2018 also completed surveys in December 2020–April 2021. A total of 5159 surveys were completed in December 2020–April 2021

on the prescribed theme of the month (such as insects and reptiles). The calendar of activities was shared digitally with parents by ICDS workers, and for families without internet connectivity, printed copies of the calendar were circulated as far as possible (Department of Women and Child Development, Government of Odisha 2020).

3 Data and sampling

Our sample frame is the universe of all 10,937 ICDS workers in three districts in Odisha—Baleshwar, Dhenkanal, and Ganjam (one district drawn from each of the three administrative revenue divisions in the state).[4] We conducted two rounds of data collection in (i) April 2018 and (ii) December 2020–April 2021. The workers were drawn from 419 ICDS sectors across the three districts.

Figure 1 illustrates the sampling and rounds of data collection in the study. Of the universe of 10,937 workers in the three study districts, 6003 were randomly selected and surveyed in April 2018. Of these workers, 3987 were surveyed again in December 2020–April 2021. In cases where we were unable to reach an ICDS worker, it was primarily due to problems with the phone number and not due to refusal to take the survey. In addition, we resampled from the universe of workers not included in the 2018 surveys (10,937 - 6003 = 4934 workers) and completed surveys with 1172 of these workers in December 2020–April 2021. Thus, a total of 5159 surveys were completed in December 2020–April 2021. This gives us a panel dataset with two rounds of surveys for 3987 workers and a cross-sectional dataset with one round of surveys for 1172 workers.

All surveys were conducted over the phone to eliminate in-person interaction (the 2018 surveys were also completed using phone surveys). To better understand the

[4] For context, India has 640 districts (2011 Census) and a population of approximately 1.4 billion—i.e., approximately 2 million individuals, on average, per district.

data, we also conducted two virtual focus group discussions with ICDS workers. Both sessions were held in July 2021, with three workers in each session, where one worker was randomly selected to participate from each of the three study districts. The findings from the sessions complement our quantitative analysis from the phone surveys.

Table 1 presents summary statistics for the 5159 ICDS workers surveyed in December 2020–April 2021. The mean age for ICDS workers in our sample is 40, with 15 years of experience working as an ICDS worker. On average, 13 girls and 13 boys were enrolled in each ICDS center as of February 2020. To assess the working conditions of ICDS centers, we surveyed workers on four indicators: 79% reported proximity to a paved road, 44% noted availability of a working toilet, while 37% had access to electricity and 59% access to potable water. ICDS workers earned, on average, Rs. 7400 monthly (USD 100). Monthly household income is Rs. 18,000 on average (USD 244).

Table 1 Summary statistics

	Mean
Age	40.48
	(7.85)
Years of experience as ICDS worker	14.82
	(7.13)
Any formal training for current role	0.86
	(0.34)
Number of girls enrolled	12.96
	(6.91)
Number of boys enrolled	12.92
	(7.31)
ICDS center near paved road	0.79
	(0.41)
Working toilet available	0.44
	(0.50)
Access to electricity	0.37
	(0.48)
Access to potable water	0.59
	(0.49)
Locus of control (2018)	4.46
	(0.89)
Public service motivation (2018)	9.22
	(0.92)
Monthly salary (rupees)	7365.94
	(538.36)
Monthly household income (rupees)	18,222.59
	(14,547.10)

Notes: The table presents summary statistics for the 5159 workers surveyed on several key variables. The time period of reference for all variables is the time of survey in 2020–21, unless otherwise noted

4 Lockdowns: red, orange, and green zone classifications

India imposed a nationwide lockdown to contain the spread of COVID-19 in the country on March 25, 2020. In April 2020, India media reported that India's Ministry of Home Affairs issued an order that divided all districts into red, orange, and green zones, based on the severity of the COVID-19 outbreak in those areas (Times of India 2020). Red zones saw the strictest lockdown measures, while orange and green zones saw measures that were less strict. Appendix A details the restrictions in each zone color category. Beginning in June 2020, lockdown rules became the jurisdiction of state governments and states were allowed to create their own red, orange, and green zones.

To study geographic and temporal variation in the lockdown measures in Odisha, we utilize data collected from ICDS workers during the surveys conducted in December 2020–April 2021. In these surveys, we asked workers to recall the restrictions in their area at three different points in time, equally spaced three months apart in May, August, and November 2020. Importantly, we asked workers to state their zone color category in the given month for their immediate geographic area, since targeted lockdown measures were often implemented below the district level. This is the key source of variation that we use in this study. While Ravindran and Shah (2023) use variation in lockdown zones across districts as designated by the central government, we utilize a finer level of geographic and temporal variation in lockdown measures as implemented by the state government in Odisha.

In May 2020, we observe substantial variation across areas in lockdown measures—45% of workers reported working in red zones, while 16% and 39% reported working in orange and green zones, respectively. Fewer than 10% of ICDS workers reported that public transport services (rickshaws, taxis, buses, etc.) were allowed to operate in their area in May 2020. A similarly small number of workers reported that offices were allowed to operate at this point in time. Almost no workers reported permission for cross-district movement of individuals and vehicles, and almost all workers reported that ICDS centers were closed in May 2020. We note a very similar picture in August 2020.

There was a marked improvement in lockdown restrictions by November 2020. More than 4000 out of 5159 workers surveyed reported no restrictions on the operation of public transport, offices, and movement of individuals and vehicles across districts. This relaxation was in line with a fall in the number of new COVID-19 cases in the country. Notably, however, most ICDS workers reported that ICDS centers remained closed in November 2020. As per state government directives, all ICDS centers were closed from March 14, 2020 to January 31, 2021. The centers were allowed to open on February 1, 2021, but were subsequently ordered to close again on April 19, 2021, owing to the second wave of COVID-19 infections in the state.

What do the lockdown zone color categories identify? We break down ICDS worker reports of lockdown measures by the three zone color categories in Fig. 2. The figure reveals two important patterns: first, the stringency in the lockdown zone color categories almost always monotonically increases when moving from green, orange, to red zones across all four variables. Green zones saw the largest fraction of workers reporting no restrictions on the operation of public transport, offices, and movement

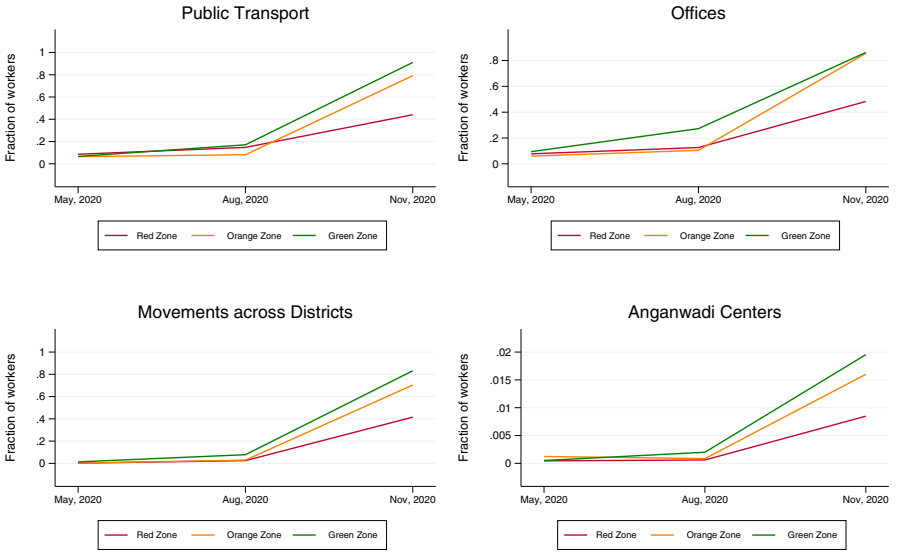

Fig. 2 ICDS worker reports of lockdown measures by zone category. Notes: n = 5159 ICDS workers. The figures plot the mean fraction of workers reporting operations of (i) public transport, (ii) offices, (iii) cross-district movement, and (iv) Anganwadi centers in the second, third, and fourth quarters of 2020, by lockdown zone color category (red, orange, and green)

of individuals and vehicles across districts, while red zones often saw more stringent restrictions. These restrictions become less stringent in all categories by November 2020. Second, while ICDS centers reported similar patterns over time, they took place at a much lower level relative to shifts in public transport, offices, and cross-district movement. Only 2% of workers in green zone areas reported no restrictions on the operation of ICDS centers in November 2020.

5 Descriptive results

5.1 Provision of preschool services

In our surveys with ICDS workers conducted in December 2020–April 2021, we asked respondents recall questions on the provision of five core ICDS services at four different points in time, equally spaced 3 months apart in February, May, August, and November 2020. We collected data on preschool activities, in addition to four other core ICDS services: (i) height and weight monitoring, (ii) provision of vaccinations (non-COVID vaccinations such as for MMR), (iii) distribution of take-home rations, and (iv) home visits.

Figure 3 breaks down the provision of preschool services by zone color category. We plot the fraction of workers providing the given services relative to the total number of workers in each zone color category for the given month. To extend the plots back to February 2020, we assume the same zone color categories that were reported by workers for May 2020. While there were no lockdown measures in February 2020,

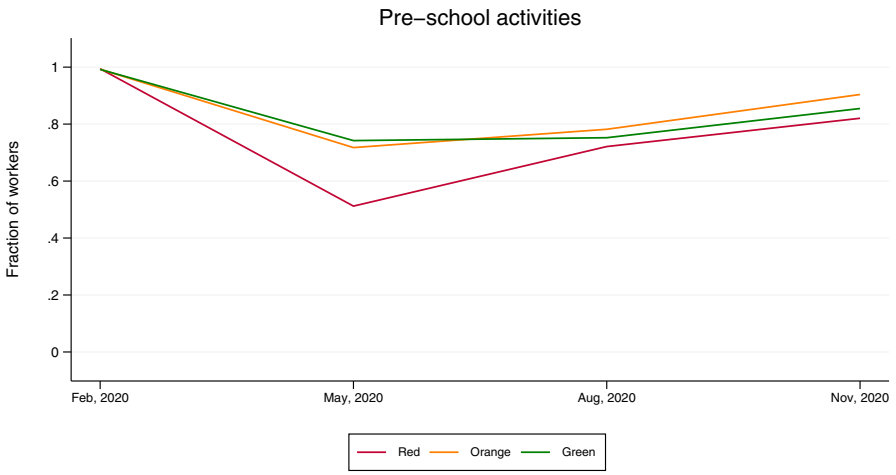

Fig. 3 Provision of preschool services by zone category. Notes: $n = 5159$ ICDS workers. The figure plots the mean fraction of workers reporting the provision of preschool activities in each of the four quarters of 2020, by lockdown zone color category (red, orange, and green)

the categories enable us to examine differences between areas prior to the COVID-19 pandemic, which may include differences in geographic and demographic characteristics (urban versus rural areas, population density, etc.) associated with the spread of COVID-19 in subsequent months. This figure uses reports from all 5159 workers surveyed. We did not collect data on the provision of specific ICDS services such as preschool activities in 2018. We observe a sharp contraction in the fraction of workers providing preschool activities in red zones in May 2020, relative to orange and green zones. Appendix Figure B.1 shows that we do not observe similarly large differences by zone color category for the other core ICDS services: height and weight monitoring, vaccinations, take-home rations, and home visits.

5.2 Provision of COVID-19-related services

A large number of ICDS workers served as frontline workers to help curb the spread of COVID-19 in Odisha. To understand the additional duties carried out by ICDS workers, we collected data on the provision of five specific services: (i) awareness campaigns, (ii) community surveillance, (iii) distribution of safety kits, (iv) activities to curb child marriage, and (v) assistance in government support programs.

In May 2020, almost all surveyed ICDS workers reported performing duties for COVID-19 awareness campaigns and carried out community surveillance activities for COVID-19. Approximately 60% of surveyed workers also reported involvement in COVID-19-related government support programs. The disaggregation by zone categories in Appendix Figure B.2 highlights that workers in red zones were more likely to be involved in government support programs in all months, likely due to the greater stringency of lockdown measures and higher number of COVID-19 cases in these areas.

In August and November 2020, we observe a decline in the number of ICDS workers reporting provision of COVID-19-related services, with the exception of activities to curb child marriage. This decline is consistent with the reduction in the number of new COVID-19 cases reported in Odisha over this time period. As child marriage was highlighted as an issue of importance following the impacts of the COVID-19 pandemic and lockdowns on families, ICDS workers steadily increased their provision of activities to curb child marriage. In November 2020, 65% of surveyed ICDS workers performed duties aimed at curbing child marriage.

5.3 Labor supply and time allocation across tasks

We asked ICDS workers about their labor supply and time allocation across tasks to better understand the impact of the COVID-19 pandemic and lockdown restrictions on them. We collected data on three specific categories: (i) preschool activities, (ii) the broad umbrella of ICDS-related activities, and (iii) COVID-19 activities as well as other non-ICDS activities such as work under the National Rural Employment Guarantee Act (NREGA).

Figure 4 plots the mean weekly hours worked by ICDS workers for the three categories. A comparison of the hours of labor supplied by ICDS workers between April 2018 and February 2020 across the three categories reveals little change across lockdown zones, strengthening our parallel trends assumption required for identification in our difference-in-differences strategy.

ICDS workers reported spending approximately 4 h a week on COVID-19-related tasks in May 2020. However, the time spent on COVID-19-related duties crowded out time spent on ICDS-related activities, particularly the provision of preschool services. Breaking down the hours worked by zone categories in Fig. 4, we observe that workers in red zones decreased their weekly time spent on the provision of preschool activities by 11.7 h in May 2020 (on a base of 15.8 h in February 2020), and this is larger than the decreases observed in green and orange zones. This figure utilizes the sub-sample of workers who completed surveys in 2018.

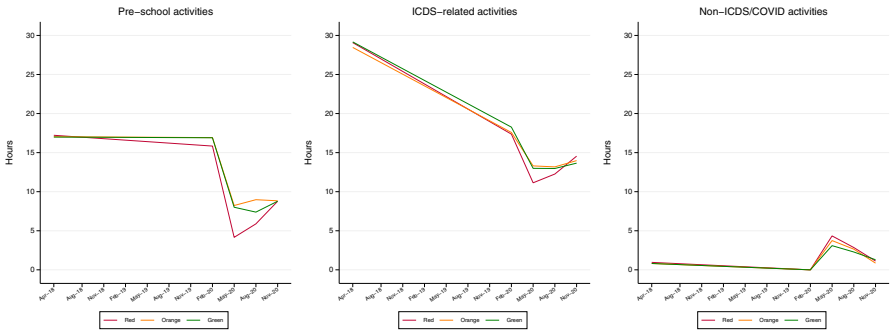

Fig. 4 Hours worked by ICDS workers by zone category. Notes: n = 3987 ICDS workers. The figures plot the mean weekly number of hours worked by ICDS workers on (i) preschool activities, (ii) ICDS-related activities (including preschool as well as height and weight monitoring services, take-home ration distribution, and home visits), (iii) COVID-related activities, including other non-ICDS work on NREGA activities in April 2018, by lockdown zone color category (red, orange, and green)

6 Empirical strategy

To better understand the differential impacts outlined in Sect. 5 in sectors most affected by the lockdown measures relative to sectors least affected by the measures, we employ a difference-in-differences empirical strategy. Using the quasi-random government classification of sectors into red, orange, and green zones, we exploit the panel structure of the worker-quarter level data and run the following specification for ICDS worker i in sector s in quarter q:

$$Y_{isq} = \alpha + \gamma_s + \lambda_q + \sum_{t=2}^{4} \beta_{t,r}\theta_t \times RedZone_{sq} + \sum_{t=2}^{4} \beta_{t,o}\theta_t \times OrangeZone_{sq} + \boldsymbol{\beta}\mathbf{X_{isq}} + \varepsilon_{isq} \quad (1)$$

where Y_{isq} refers to the outcome variable of interest as reported by worker i in sector s in quarter q of 2020, γ_s are sector fixed effects, and λ_q are quarter fixed effects. The sector fixed effects capture time-invariant characteristics of sectors, including the sector-specific population in 2020. Quarter fixed effects flexibly control for country-wide trends in the outcome variables of interest over time. The combination of fixed effects used allows us to use variation within a given quarter across sectors, in addition to variation within a given sector over time. $\mathbf{X_{isq}}$ is a vector of worker-specific controls including age and years of experience.

$RedZone_{sq}$ and $OrangeZone_{sq}$ are dummy variables equal to 1 for sectors in red and orange zones, respectively, in quarter q, and 0 otherwise. θ_t refer to quarter of 2020 dummies corresponding to the recall month of May in the second quarter 2020 ($t = 2$) to the recall month of November in the fourth quarter of 2020 ($t = 4$). $\{\beta_{t,r}\}$ and $\{\beta_{t,o}\}$ are the coefficients of interest. The coefficients $\{\beta_{t,r}\}$ capture the impact of sectors classified into the red zone relative to the impact of sectors classified into the green zone, in quarter t relative to the recall month of February in the first quarter of 2020 (the omitted quarter, i.e., the pre-COVID period). Similarly, the set of coefficients $\{\beta_{t,o}\}$ captures the impact of sectors classified into the orange zone relative to the impact of sectors classified into the green zone, in quarter t of 2020 relative to the first quarter of 2020. The sector fixed effects absorb the time-invariant differences between red (orange) and green zones, and the estimated coefficients are relative to the difference between red (orange) and green zones in February 2020. All standard errors are clustered by sector and quarter.

For key variables of interest such as labor supply, we exploit an earlier wave of surveys conducted with the ICDS workers in April 2018. Here, we use April 2018 ($t = 0$) as the base reference period and estimate

$$Y_{isq} = \alpha + \gamma_s + \lambda_q + \sum_{t=1}^{4} \beta_{t,r}\theta_t \times RedZone_{sq} + \sum_{t=1}^{4} \beta_{t,o}\theta_t \times OrangeZone_{sq} + \boldsymbol{\beta}\mathbf{X_{isq}} + \varepsilon_{isq} \quad (2)$$

where the coefficients $\{\beta_{t,r}\}$ capture the impact of sectors classified into the red zone relative to the impact of sectors classified into the green zone, in quarter t relative to the recall month of April 2018 (the omitted period). Similarly, the set of coefficients $\{\beta_{t,o}\}$ captures the impact of sectors classified into the orange zone relative to the impact of sectors classified into the green zone, in quarter t of 2020 relative to April 2018.

We stress that while these lockdowns were occurring, there were also increased COVID cases, income and consumption loss due to job insecurity, and overall increased economic insecurity and poverty-related stress, as well as increases in violence against women, food insecurity, and declines in female mental health as a result of COVID-19 containment policies (Ravindran and Shah 2023; Bau et al. 2022). While an analysis of the relative importance of possible channels is beyond the scope of the paper, the reduced form estimates might be driven by a combination of these pathways.

We explore the roles played by two important mediators of service delivery (Z_i) as measured in 2018: (i) worker's locus of control and (ii) public service motivation, in the provision of (and hours spent on) preschool services over months using the following triple-difference specification:

$$\begin{aligned} Y_{isq} = \alpha + \gamma_s + \lambda_q + \sum_{t=2}^{4} \beta_{t,r}\theta_t \times RedZone_{sq} + \sum_{t=2}^{4} \beta_{t,o}\theta_t \times OrangeZone_{sq} \\ + \beta_z Z_i + Z_i \times RedZone_{sq} + Z_i \times OrangeZone_{sq} + \sum_{t=2}^{4} \beta_{t,z}\theta_t \times Z_i \\ + \sum_{t=2}^{4} \beta_{t,rz}\theta_t \times RedZone_{sq} \times Z_i + \sum_{t=2}^{4} \beta_{t,oz}\theta_t \times OrangeZone_{sq} \times Z_i + \boldsymbol{\beta}\mathbf{X_{isq}} + \varepsilon_{isq} \quad (3) \end{aligned}$$

The set of coefficients $\{\beta_{t,rz}\}$ captures the differential impact of sectors classified into the red zone relative to the impact of sectors classified into the green zone, in quarter t relative to the recall month of February in the first quarter of 2020 (the omitted quarter, i.e., the pre-COVID period), for workers with a high value of characteristic Z_i. Locus of control was measured using a 10-item Work Locus of Control Scale (Spector 1988). This is a well-validated instrument that is widely used in psychology and other disciplines. Public service motivation was measured using a 5-item module. The set of questions corresponding to each measure is given in Appendix A.3. Workers are defined as having a high locus of control or public service motivation if they scored at or above the median score on the respective modules.[5] The set of coefficients $\{\beta_{t,oz}\}$ captures the impact of sectors classified into the orange zone relative to the impact of sectors classified into the green zone, in quarter t of 2020 relative to the first quarter of 2020, for workers with a high value of characteristic Z_i.

7 Results on the provision of services and time allocation across tasks

Table 2 presents the results for the provision of preschool services. As outlined in Sect. 5, we see the largest differential impact of the lockdowns on the provision of preschool services between red and green zones in May 2020. ICDS workers in red

[5] We present results using an alternative definition (scores at or above the mean score) to assess the robustness of our results in Appendix Tables C.2 and C.3. For locus of control, the mean and median are equal and so the results do not differ. For public service motivation, the mean is slightly smaller than the median value. The estimated impacts on preschool service provision and hours spent are similar, if only slightly larger, when using the mean scores. To be conservative, we report the estimated impacts using the median scores in the main text and mean scores in the appendix.

Table 2 Differential impact on preschool services

	Preschool activities (1)
Red zone × May 2020	−0.232***
	(0.007)
Red zone × Aug 2020	−0.036*
	(0.012)
Red zone × Nov 2020	−0.068**
	(0.018)
Orange zone × May 2020	−0.025
	(0.014)
Orange zone × Aug 2020	0.040*
	(0.015)
Orange zone × Nov 2020	0.063**
	(0.016)
Dependent variable mean (all zones, May 2020)	0.644
Observations	20,524

Notes: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. The dependent variable is an indicator that takes the value 1 if the worker reported conducting any preschool activities in the given month, and 0 otherwise. The table reports coefficients $\{\beta_{t,r}\}$ and $\{\beta_{t,o}\}$ from Eq. 1. The red zone × month coefficients are estimates of $\{\beta_{t,r}\}$, the differential impact of red versus green zone sectors in quarter t relative to the first quarter of 2020 (the omitted quarter in the pre-pandemic period). The orange zone × month coefficients are estimates of $\{\beta_{t,o}\}$, the differential impact of orange versus green zone sectors in quarter t relative to the first quarter of 2020. The regression includes sector fixed effects, month-year fixed effects, and controls. Standard errors are clustered by sector and quarter

zone sectors were 23 percentage points less likely to provide pre-school services relative to workers in green zones in May 2020, relative to the first quarter of 2020 (this is equivalent to a 23% reduction since all workers reported providing preschool services in the first quarter of 2020). The negative impacts persist in August and November 2020, although the magnitudes are smaller: we estimate a 3.6 percentage point differential impact in August and 6.8 percentage point differential impact in November 2020.

Appendix Table C.1 also shows smaller differential impacts in the provision of other core ICDS services including height and weight monitoring services, vaccinations, take-home ration distribution, and home visits in red zone sectors relative to green zones in May 2020, relative to the first quarter of 2020. ICDS workers were 5–7 percentage points less likely to provide all of the above services in May 2020, and a gap persists for the provision of vaccinations and home visits in November 2020 when comparing red and green zones.

The differential impacts on provision of preschool, ICDS, and COVID-19-related services are reflected in the labor supply of workers and time allocation across tasks. Column (1) of Table 3 highlights that ICDS workers in red zones reported spending an estimated 4.08 fewer hours on preschool activities per week in May 2020 relative to workers in green zones. On a base of 16.5 h of provision of preschool services per week

Table 3 Differential impacts on hours worked

	Preschool activities (1)	COVID activities (2)	ICDS-related activities (3)
Red zone × May 2020	−4.082***	1.123***	−1.888***
	(0.191)	(0.029)	(0.127)
Red zone × Aug 2020	−1.164***	0.253**	−0.429*
	(0.190)	(0.065)	(0.161)
Red zone × Nov 2020	−0.685	0.010	0.827*
	(0.421)	(0.130)	(0.329)
Orange zone × May 2020	0.131	−0.048	0.675*
	(0.357)	(0.038)	(0.298)
Orange zone × Aug 2020	1.850***	0.048	0.553*
	(0.281)	(0.044)	(0.238)
Orange zone × Nov 2020	0.142	−0.338**	0.527
	(0.310)	(0.084)	(0.386)
Dependent variable mean (All zones, May 2020)	6.471	3.491	12.249
Observations	19,932	19,927	19,912

Notes: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. The dependent variables are mean weekly hours spent on various activities in the given month. ICDS-related activities include preschool as well as height and weight monitoring services, take-home ration distribution, and home visits. The table reports coefficients $\{\beta_{t,r}\}$ and $\{\beta_{t,o}\}$ from Eq. 2. The red zone × month coefficients are estimates of $\{\beta_{t,r}\}$, the differential impact of red versus green zone sectors in quarter t relative to April 2018. The orange zone × month coefficients are estimates of $\{\beta_{t,o}\}$, the differential impact of orange versus green zone sectors in quarter t relative to April 2018. The regressions include sector fixed effects, month-year fixed effects, and controls. Standard errors are clustered by sector and quarter

in February 2020 across all workers, this represents a 4.08/16.5 = 24.7% difference in hours spent on preschool activities, which is in line with the 23 percentage point difference in provision of preschool services estimated in Table 2. Part of this impact can be explained by ICDS workers in red zones spending 1.12 more hours per week on COVID-19-related activities in May 2020 relative to workers in green and orange zones (column (2) of Table 3). This crowded out time spent on preschool and ICDS-related activities in May 2020. Across all ICDS services, workers in red zones reported spending 1.89 fewer hours relative to workers in green and orange zones (column (3) of Table 3). We also observe that in August 2020, workers in red zones reported spending an estimated 1.16 fewer hours on preschool activities per week relative to workers in green zones.[6]

8 Exploring the roles of locus of control and public service motivation

A study of the factors mediating the provision of public services, and in particular, preschool services, in times of crisis and pandemics is of primary policy interest. We

[6] ICDS workers also spend time on other tasks including several administrative duties, but given survey time constraints, we did not ask them for an exhaustive list of tasks and their time allocation.

study the role of work locus of control and public service motivation in mitigating the negative impacts of the provision of preschool services observed during the pandemic. These variables are measured pre-COVID with the subsample of workers who completed the earlier wave of surveys in 2018.

Why does public service motivation matter in our context? India's ICDS, like many flagship public sector programs in developing countries, is limited in its scope to motivate workers through high-powered monetary incentives. Wages remain low overall, despite demands from ICDS workers and unions to increase wages (Odisha Diary Bureau 2022). Thus, the role of non-monetary means of motivating public sector workers is crucial. The COVID-19 pandemic also led to a worsening of mental health in India and other developing economies (Bau et al. 2022). Here, public service motivation and locus of control may mediate the effects of stress on work engagement, as shown in recent studies of workers during the pandemic (Mahmoud et al. 2021; Jeong et al. 2022). Furthermore, pandemic and crisis settings require workers to adopt innovative ways of delivering services. In Odisha, examples include the innovative use of "Maa Gruhas," or maternity waiting homes, to handle problematic antenatal care cases (Kundapur et al. 2022). As Miao et al. (2018) argue, public service motivation can enhance innovative behavior among civil servants.

Table 4 presents results from the separate estimation of Eq. 3 for work locus of control and public service motivation in columns (1) and (2), respectively. We observe that workers who reported having an above-median level of control over their work were 6.2 percentage points more likely to provide preschool services in red zones in May 2020 relative to green zones in Feb 2020 (pre-COVID). We do not observe a similar differential impact for workers in orange relative to green zones.

Table 4 The roles of locus of control and public service motivation on the provision of preschool services

	Provision of preschool services	
	(1)	(2)
High locus of control × red zone × May 2020	0.062*	
	(0.022)	
High locus of control × orange zone × May 2020	0.003	
	(0.027)	
High public service motivation × red zone × May 2020		0.085**
		(0.021)
High public service motivation × orange zone × May 2020		0.114**
		(0.033)
Dependent variable mean (All zones, May 2020)	0.644	0.644
Observations	13,984	13,984

Notes: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. The sample consists of worker-month level reports on the provision of preschool services from the sub-sample of 3987 workers who completed surveys in 2018. The table reports the coefficients $\{\beta_{t,rz}\}$ and $\{\beta_{t,oz}\}$ from OLS estimation of Eq. 3. The terms "high locus of control" and "high public service motivation" are dummy variables. Workers are defined as having a high locus of control or public service motivation if they scored at or above the median score on the respective modules. The regressions include sector fixed effects and month-year fixed effects, as well as worker-level controls for age and years of experience. Standard errors are clustered by sector and quarter and are shown in parentheses

Column (2) shows that workers who reported having an above-median level of public service motivation were 8.5 percentage points more likely to provide preschool services in red zones in May 2020 relative to green zones in Feb 2020. Such workers were also 11.4 percentage points more likely to provide preschool services in orange relative to green zones.

These magnitudes are large relative to the 23 percentage point differential impact in the provision of preschool services that we estimate in May 2020 in red relative to green zones. Although they do not completely offset this reduction, higher control and public service motivation offset the differences by 27% and 37%, respectively.

We observe a similar pattern when we explore heterogeneous impacts on the hours spent by workers on preschool activities in Table 5. In column (1), we observe that workers who have an above-median level of control over their work spent 1.8 more hours on preschool services in red zones in May 2020 relative to green zones in Feb 2020 (pre-COVID). We do not observe a similar differential impact for workers in orange relative to green zones.

Column (2) shows that workers with an above-median level of public service motivation spent 2.3 more hours on preschool services in red zones in May 2020 relative to green zones in Feb 2020. We do not observe a similar differential impact for workers in orange relative to green zones.

9 Discussion and policy implications

We conducted 5159 surveys and leverage temporal and spatial variation in India's intensity of lockdowns to quantify disruptions to preschool and health services in the country. When measures were most stringent in May 2020, we find a 23 percentage point reduction in the provision of preschool services by ICDS workers in red zone sectors relative to green zone sectors. This is partly due to a reallocation of time towards COVID-19-related tasks, which crowded out time available for preschool activities. Pre-COVID measures of high worker locus of control and public service motivation offset the differential impacts in service provision by 27–37%.

The differential impacts in the provision of preschool services, typically provided within ICDS centers, are consistent with the closure of ICDS centers in May 2020. Our focus group discussions revealed that ICDS workers often conduct preschool activities in groups, and COVID-19 restrictions on gatherings made the provision of preschool services challenging. While some workers attempted to provide these services during home visits, many parents resisted workers spending an extended duration of time in their homes due to fear of COVID-19. Workers also reported that many homes did not have the adequate space or environment conducive for such activities. Furthermore, preschool activities typically require at least 2 h, and this time commitment made individual one-on-one sessions impractical given the number of home visits that ICDS workers had to conduct.

Our results on the role of public service motivation also have important policy implications on recruitment in the public sector. Organizations may consider identifying and recruiting workers with high public service motivation, as these workers might be more able to reduce the negative impacts on public service provision during

Table 5 The roles of locus of control and public service motivation on hours spent on preschool activities

	Hours spent on preschool activities	
	(1)	(2)
High locus of control × red zone × May 2020	1.805***	
	(0.364)	
High locus of control × orange zone × May 2020	0.556	
	(0.479)	
High public service motivation × red zone × May 2020		2.298**
		(0.510)
High public service motivation × orange zone × May 2020		0.431
		(0.558)
Dependent variable mean (All zones, May 2020)	6.566	6.566
Observations	18,068	18,068

Notes: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. The sample consists of worker-month level reports on the hours spent on preschool activities from the sub-sample of 3987 workers who completed surveys in 2018. The table reports the coefficients $\{\beta_{t,rz}\}$ and $\{\beta_{t,oz}\}$ from OLS estimation of Eq. 3. The terms "high locus of control" and "high public service motivation" are dummy variables. Workers are defined as having a high locus of control or public service motivation if they scored at or above the median score on the respective modules. The regressions include sector fixed effects and month-year fixed effects, as well as worker-level controls for age and years of experience. Standard errors are clustered by sector and quarter and are shown in parentheses

periods of crisis and pandemics. Such recommendations are in line with the growing work on public service motivation: in a comprehensive review of the literature, Ritz et al. (2016) note that the most frequent recommendation was that public organizations should assess job applicants' levels of public service motivation and consider this in selection decisions.

Beyond hiring decisions, organizations have an important role in fostering public service motivation (Moynihan and Pandey 2007). Here, we contribute to the policy debate on the use of management practices that could increase public service motivation. Our results on locus of control are consistent with policies in which frontline workers participate in important decisions pertaining to the delivery of services (this has also shown to be important in other contexts; see for example, Giauque et al. 2013).

Lastly, our results on worker locus of control are consistent with recent evidence showing that locus of control affects prosocial behavior and the provision of public goods in various settings in Germany and the U.S. (Andor et al. 2022). Given the links between internal locus of control and preferences for agency, our policy recommendations include interventions that provide more control to workers over their work and time allocation across tasks (Caliendo et al. 2023).

Taken together, our findings have important policy implications as India and LMICs prepare for future pandemics. Neuman and Powers (2021) note, analyzing policy responses in LMICs across Ethiopia, Liberia, Pakistan, and Tanzania, that a lack of attention has been given to early childhood services, with higher priority given to students in primary and secondary schools. Our results on disruptions to early

childhood services are relevant to understand the learning losses seen in school grades and may have longer-term implications that we have yet to learn about.

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Data Availability Restrictions apply to the availability of the underlying data for this study due to permissions relating to the access of ICDS workers and so are not publicly available. The data are, however, available from the authors upon reasonable request.

Declarations

Conflict of interest The authors declare no competing interests.

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