Government transfers, COVID-19 shock, and food insecurity: Evidence from rural households in India

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Abstract
The coronavirus disease 2019 (COVID-19) pandemic has decimated the lives and livelihoods of people worldwide. The impact of COVID-19 has been especially devastating for low-income families in rural areas of India. Soon after the nationwide lockdown was announced, food insecurity became pervasive in rural areas, as many families relied on daily wage work to fund necessities. By providing cash transfers and additional foodgrains, Indian policymakers acted swiftly to reduce the financial impact on family income and consumption. This paper investigates the factors affecting rural families’ participation in the cash transfer program and the effect of government cash transfers on food insecurity. Results indicate that India’s government cash transfer program decreased moderate food insecurity by 2.4% and severe food insecurity by about 0.92% [EconLit Citations: O12, I31, I32, I38].

Keywords
COVID-19, Food Insecurity Experience Scale, Lewbel IV, Pradhan Mantri Garib Kalyan Yojana, Rasch Model

INTRODUCTION

In early January 2020, the coronavirus disease 2019 (COVID-19) pandemic spread across the globe. It became perhaps the most significant global health crisis within months, posing unprecedented humanitarian challenges and jeopardizing millions’ food security. Before the pandemic’s arrival, 135 million people worldwide faced extreme...
hunger. That figure could rise to a staggering 265 million people by the end of 2020 (WFP, 2020). To circumvent the contagion effects of the COVID-19 pandemic, the Indian government, on March 24, 2020, imposed one of the longest and strictest countrywide lockdowns around the globe. The lockdown has been extended several times, and these extensions will have severe implications for India's economy, which has been slowing since 2016. During the nationwide lockdown from April to June 2020, India's Gross Domestic Product (GDP) dropped by a massive 24.4% (Gol, 2021). In contrast, in the second quarter of 2020–2021 (July–September 2020), the economy contracted further by about 7.4%. However, the overall Indian GDP contracted by 7.3% in real terms during 2020–2021 (Trading Economics, 2020). The unemployment rate peaked at 23.5% during the lockdown period. The overall unemployment fell to 7.1% during 2020–2021. The year-on-year urban unemployment rate jumped from 8.8% in April–June 2019 to a staggering 20.8% in April–June 2020 (PLFS, 2020–21). In terms of food insecurity, official statistics and other macroeconomic indicators do not shed much light. Drèze and Somanchi (2021) focused on several studies, and findings suggest that a large proportion of households were eating less than usual at that time and the hardship of the COVID pandemic lasted well even after 9 months of lockdown. Furthermore, the nation's food security status was similarly precarious before the lockdown. India ranked 102 out of 117 countries in the 2019 Global Hunger Index (Grebmer et al., 2019). That ranking is worse than neighboring countries like Bangladesh, Nepal, and Pakistan, even though India's per-capita GDP is significantly larger in purchasing-power-parity terms (World Bank, 2020).

The Central Government funds more than 1000 welfare programs, and the number of welfare programs increases significantly if we consider State-level welfare programs. The Central and State government welfare programs accounted for about 8.8% of the country's GDP (Economic Survey, 2020–21). In other words, the Central and State governments together spent about 8.8% of their budget on welfare programs. About 4.4% of the welfare expenditures were allocated to Public Distribution System (PDS), fertilizer subsidy, Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), Liquified Petroleum Gas, Pension programs, National Health Mission, Integrated Child Development Services' Programs (ICDP), and Pradhan Mantri Kisan Samman Nidhi (PM-KISAN). While some above programs deliver cash directly to the beneficiaries, others provide subsidized goods and services for consumption. Cash transfers are a crucial component of social protection not only for Indians but globally. There is a growing interest in the promise of cash transfers to improve outcomes for poor people in low-, middle-, and even high-income countries.

The extent of the food security problem in India varies by region and state. Wealthy states and states with high agricultural output are less likely to be food insecure. However, the eastern region, comprising east Uttar Pradesh, Bihar, Jharkhand, Odisha, and West Bengal, represents a relatively underdeveloped region of the country. It also accounts for 28% of India's total population (93.5 million poor households).² The eastern region is beleaguered by low per-capita income, low anthropometric parameters among inhabitants, and high food insecurity. Data from the recent National Family Health Survey (2019–2020) reveal high incidences of stunting (35.5%), wasting (19.3%), underweight (32.1%), and anemia in children (67.1), and women (57.0) in India. Similarly, high incidence rates were observed in Bihar, Jharkhand, Odisha, West Bengal, and Uttar Pradesh (Appendix Table A1). Studies on malnutrition that have been conducted across India report severe levels of food insecurity in the eastern states. The data reveals that food insecurity is heavily concentrated in Bihar, Jharkhand, Chhattisgarh, and Odisha (Gulati et al., 2012). The pandemic-induced lockdown is expected to exacerbate the food insecurity problem further.

The government of India has taken several steps to combat the pandemic crisis. On March 26, 2020, the Pradhan Mantri Garib Kalyan Yojana (PMGKY³) relief package of INR 1.7 lac crore (USD 25 billion) was announced. PMGKY initiatives focused primarily on supporting rural communities, poor people, wage workers, migrant workers, farmers, women, and the physically challenged and ensuring national food security. The PMGKY included cash transfers for farmers and women, conditional cash transfers for low-income families to buy cooking gas in tanks.

²https://www.rbi.org.in/scripts/PublicationsView.aspx?id=16603
³A brief background of the PMGKY program is explained in Appendix A1.
and free food rations for the vulnerable. In the second lockdown phase, the government allowed money to be allocated to agricultural activities starting on April 20, 2020.

Moreover, on May 17, 2020, an additional INR 1 lac crore (USD 15.38 billion) was allocated to programs designed to bolster agricultural infrastructure. Specifically, the subsidy included additional emergency working capital through National Bank for Agriculture and Rural Development (NABARD), faster disbursal of agricultural loans, the formation of 10,000 farmer producer organizations (FPOs), and the integration of 177 new Mandis with electronic National Agriculture Marketing (e-NAM). Most policy experts were astounded because of the swift timing of the policy enactment and the amount of money allocated to mitigate the pandemic's devastating effects. However, before declaring the PMGKY a success, one must evaluate the program’s role in mitigating the impacts of the COVID-19 pandemic in eastern India.

Herein lies the twofold objective of this study: first, to examine the status of food insecurity among rural households, and second, to assess the current state of the short-term effectiveness of PMGKY in mitigating food insecurity among these households. The study uses a probit model to identify the determinants of beneficiary households of PMGKY. A Rasch model is used to estimate the prevalence of food insecurity among rural families and an instrumental variable approach (IV) to assess the impact of transfer programs (under the PMGKY) on the food insecurity experience scale (FIES)—namely on the prevalence of moderate and severe food insecurity. FIES was developed by the Food and Agriculture Organization (FAO) of the United Nations as a mechanism for quantifying food insecurity severity and has been used in several studies (see Smith, Kassa, et al., 2017; Smith, Rabbitt, et al., 2017; Wambogo et al., 2018). It is an experience-based metric and relies on direct responses to eight specific food security questions (explained in Table 2 and see below for a discussion on FIES methodology). Finally, our study uses 2020 data from 2599 rural households from five eastern states of India: Bihar, Jharkhand, Eastern Uttar Pradesh, Odisha, and West Bengal.

2 | PREVALENCE OF FOOD INSECURITY—RASCH MODEL

Several studies in the literature point out that food insecurity in a household is characterized initially by worry about having enough food, making dietary changes, reduction in quantity and quality of food consumed, and fasting or skipping meals (Marques et al., 2015; Melgar-Quinonez, 2009; Owino et al., 2014). These experiences are the same across developed and developing countries. The FAO's Voices of the Hungry Project (FAO-VoH) introduced FIES in 2014 as a global standard for monitoring hunger and has since worked to promote its incorporation into national surveys. Smith, Rabbit, et al. (2017) conclude that an experience-based metric effectively improves policies to combat food insecurity. The FIES Survey Module collects self-reported data on respondent experiences and behavior related to food access due to lack of money or other resources over a one-month recall period, irrespective of the frequency of occurrence. It comprises eight questions that measure the extent of food insecurity and give it a classification ranging from moderate to severe. "Moderate" food insecure suggests that people will typically eat low-quality diets and may reduce the consumption of food they would normally eat as before. Whereas "severe" food insecure people may experience a whole day without eating due to lack of money or other resources. The FIES has been used to assess food security issues in communities worldwide, including in the US and Latin America (See Smith, Rabbit, et al., 2017). For this study, we derive two outcome measures of severity of food insecurity using the same eight questions constructed by FAO-VoH.

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4This was announced as a part of a second relief package, which was mainly focused on MSMEs and providing infrastructure support.
5An electronic trading portal that provides an opportunity for buyers and sellers to trade their commodities at real-time prices determined on the basis of actual demand and supply.
6The Rasch model is an item-response-theory model that is used to relate responses from multiple binary (yes/no) questions about an underlying several conditions.
7See Coates (2013), Jones et al. (2013), and Marques et al. (2015) for a history of the evolution of food insecurity.
Several studies (Andrich, 1988; Bickel et al., 2000; Moffitt & Ribar, 2016; Rasch, 1960) have employed the Rasch model to examine food security. Similarly, in this study, we have employed the Rasch Model to construct a single-parameter logistic measurement for FIES data. The above model assumes that a respondent’s position and food insecurity items can be located on a one-dimensional scale. The model postulates that the log-odds of a respondent, \( R \), saying “yes” to item \( J \) is a linear function of the difference between the severity of the food insecurity condition experienced by \( R \) and the seriousness of item \( J \). Nord (2014) argued that the odds that a family will affirm right at the severity level of food insecurity is 1, corresponding to a 0.5 probability. By coding \( X_{R,J} \) (the answer is given by respondent \( R \) to item \( J \)) as 1 for “yes” and 0 for “no.” Specifically,

\[
p = \text{Prob}(X_{R,J} = 1) = \frac{e^{a_R - b_J}}{1 + e^{a_R - b_J}} = \ln \left( \frac{p}{1 - p} \right) = a_R - b_J,
\]

where \( a_R \) is the position (in terms of food insecurity scale) of the respondent and \( b_J \) is the food insecurity item on the same scale. The scale is referred to as a scale of “severity.” In other words, the extent of an individual’s inability to access needed food. Although Rasch linear measures are expressed in log-odd units, the outcome can be converted to a 0–100 scale. Like many other widely accepted scales, the FIES is a statistical scale designed to measure unobservable traits. The primary appeal of the most straightforward formulation of the traditional Rasch model (Equation (1)) resides in the fact that individual severity measures of food (the estimated parameters) are linked monotonically (albeit not linearly) to the raw score. In other words, food insecurity is connected with the number of affirmed items. Additionally, Nord (2014) noted that linear transformation retains conjoint additivity.

However, any measure of food insecurity used in a global monitoring framework must ensure that the estimated prevalence of food insecurity rates is comparable over time and across countries. FAO-VoH designed its model on the premise that certain dimensions of the food insecurity experience are universal and accumulated enough research to ensure cross-cultural validity and applicability of food insecurity measures. Thus, provide a standardized metric for international comparisons (Álvarez et al., 2008; Coates et al., 2006; Derrickson et al., 2000; Hromi-Fiedler et al., 2009; Melgar-Quíñonez, 2009; Segall-Corrêa et al., 2008; Segall-Corrêa et al., 2014; Swindale & Bilinsky, 2006).

This study uses a global FIES reference scale/threshold of 2014–2016, as defined by FAO-VoH. The global FIES reference scale was created by assigning each item the median value of severity it revealed across datasets from nearly 150 countries and then normalizing them to have mean zero and unit standard deviation. This study uses two thresholds of food insecurity—moderate and severe. We define “moderate” and “severe” food insecurity levels based on the observed pattern and location of the items along the severity scale. People experiencing moderate food insecurity will typically eat low-quality diets and reduce their total intake. Those experiencing severe food insecurity may go an entire day or more without eating due to a lack of money or other resources. In this study, moderate and severe food insecurity are two FIES-based indicators used as outcome variables of rural households in eastern India.

### 3 | SURVEY DATA

Our study area comprises Bihar, eastern Uttar Pradesh (UP), Jharkhand, Odisha, and West Bengal. Due to the lockdown and prevalence of COVID-19, the survey was conducted by phone. The sample of the telephonic survey was based on a 2018 survey of 4083 rural households from the same states. In the end, we were able to contact

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8The standardization values are obtained from FAO’s global scale parameter for the period of 2014-2016. The values have been obtained at the country level to the global standard, which is a set of item parameter values based on results from over 140 countries covered by the Gallup World Poll in 2014, 2015, and 2016.
9The results obtained through scales are comparable across countries using certain statistical techniques (i.e., Item Response Theory (IRT) models).
10Conjoint means measurement of persons and items on the same scale and additivity refers to the equal-interval property of the scale.
11The threshold value or severity scale for moderate class is -0.1151.
12The threshold value or severity scale for severe class is 2.9826.
2599 rural households, a sub-set of the 2018 survey, during June–July 2020. The sample distribution of telephonic surveys for each state is 789 from Bihar (30.4%), 258 from Jharkhand (9.9%), 563 from Eastern Uttar Pradesh (21.7%), 382 from Odisha (14.7%), and 607 from West Bengal (23.4%). In the 2018 survey, we followed proper sampling techniques to choose the sample size from each state and allocated the sample proportionally to the selected state’s rural population. We randomly selected 10 districts from Bihar, eight districts from eastern Uttar Pradesh, four districts from Jharkhand, four districts from Odisha, and eight districts from West Bengal. From each district, we then randomly selected two blocks and from each block, we randomly selected two villages for the final stage unit of the survey. After house listing in each village, we randomly selected 30 households in each village for the survey. The survey collected information on household characteristics, resource endowment, access to credit from various sources, and awareness of technological and social development. In a telephonic survey, we queried rural families about food security, farming operations, access to input and output markets, and the assistance provided to households.

This study separated rural families into two categories: households that received PMGKY benefits (or beneficiary households) and their counterparts (or non-beneficiary households). Table 1 provides the descriptive statistics and summary statistics of the beneficiary and nonbeneficiary households and the overall sample. Table 1 shows that the average household head (HH) was 51, and the HH of the average beneficiary household was slightly younger than the non-beneficiary HH—a difference of about 2 years. Overall, the PMGKY beneficiary households were less educated than their counterparts by about 2 years. The majority of the nonbeneficiary families belonged to the general caste of social classification, and the beneficiary families mainly were from the Other Backward Castes (OBCs), followed by Scheduled Castes (SCs) and Scheduled Tribes (STs). In eastern India, the majority of the farmers are marginal landholders (<1 ha).

However, nonbeneficiary households had more land (about 0.32 ha) than beneficiary households. The share of nonfarm income was about 44% for both categories of rural households. In beneficiary families, about 48% and 15% had access to credit and the Kisan Credit Card (KCC), respectively. More beneficiary households (48%) had access to credit than nonbeneficiary households (42%). The difference was statistically significant. Interestingly, Table 1 reveals that about 39% of beneficiary households found work under the National Rural Employment Guarantee Act of 2005, also called the Mahatma Gandhi Employment Guarantee Act (MGNREGA). In contrast, only 25% of the non-beneficiary households found work under MGNREGA. The difference was statistically significant at the 1% level of significance.

About one-third of the sample opened a savings account under the Jan Dhan Yojana Program Table 1 shows a statistically significant difference (12%) between the share of the beneficiary and non-beneficiary households who opened an account. Finally, the last two rows of Table 1 show the estimated prevalence of food insecurity among beneficiary and nonbeneficiary families. Table 1 shows that beneficiary households have a statistically significantly higher prevalence of food insecurity (for moderate and severe categories) than nonbeneficiary families.

4 | THE EXTENT OF FOOD INSECURITY IN EASTERN INDIA

Table 2 shows the state-wise self-reported food-related behaviors and experiences associated with increasing difficulties in accessing food due to COVID-19 for rural households in the sampled region. Columns 2–9 reveal the percentage of rural families who reported difficulties accessing food in the past month (at the time of the survey) during India’s lockdown period. About 56% of the sample reported being “worried” about food security. However, the percentage of households worried about food depends on if the family was a beneficiary of PMGKY subsidies.

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13Households are eligible for National Food Security Act (NFSA) card. NFSA card is the official document issued by the respective state governments and enables eligible households to buy food grains at subsidized rates under the National Food Security Act (NFSA). Whereas in 2020 Government of India announced that all NFSA beneficiaries will be covered under PMGKY program for a specific period.
### TABLE 1

Descriptive statistics of beneficiary and nonbeneficiaries of PMGKY program, India 2020.

| Variables                              | Nonbeneficiary (N = 349) | PMGKY beneficiary (N = 1762) | Overall (N = 2111) |
|----------------------------------------|--------------------------|-------------------------------|-------------------|
|                                        | Mean         | SD  | Mean        | SD  | Diff Mean     | SD  |                  |
| Age of household head (in years)       | 52.79        | 13.42 | 51.06       | 12.18 | −1.73*       | 12.40 |                  |
| Male headed household (%)              | 95.70        | 20.31 | 96.19       | 19.16 | 0.48         | 19.35 |                  |
| Household size (nos)                   | 5.69         | 2.91  | 5.48        | 2.80  | −0.21        | 2.82  |                  |
| Education (in years)                   | 7.19         | 4.97  | 5.62        | 4.76  | −1.56***     | 4.83  |                  |
| Caste (%)                              |              |      |             |      |              |      |                  |
| Scheduled caste                        | 15.19        | 35.94 | 28.05       | 44.94 | 12.87***     | 43.83 |                  |
| Scheduled tribes                       | 5.73         | 23.28 | 8.52        | 27.92 | 2.79*        | 27.22 |                  |
| Other backward caste                   | 34.38        | 47.57 | 44.07       | 49.66 | 9.68***      | 44.44 |                  |
| General                                | 44.70        | 49.79 | 19.36       | 39.53 | −25.34***    | 21.75 |                  |
| Land size (in ha)                      | 0.85         | 1.30  | 0.52        | 0.80  | −0.32***     | 0.58  | 0.91 |
| Land category (%)                      |              |      |             |      |              |      |                  |
| Landless                               | 19.48        | 39.66 | 29.34       | 45.55 | 9.86***      | 44.77 |                  |
| Marginal (<1 ha)                       | 55.59        | 49.76 | 55.68       | 49.69 | 0.09         | 49.69 |                  |
| Small (1–2 ha)                         | 15.47        | 36.22 | 10.90       | 31.17 | −4.58*       | 32.09 |                  |
| Medium and large (>2 ha)               | 9.46         | 29.30 | 4.09        | 19.80 | −5.37**      | 21.75 |                  |
| Share of income from nonfarm sector (%)| 44.71        | 30.25 | 44.33       | 27.27 | −0.38        | 27.78 |                  |
| Have access to credit (%)              | 42.12        | 49.45 | 48.26       | 49.98 | 6.14*        | 49.94 |                  |
| Household with at least one-member migrant to other place for work (%) | 24.64 | 43.15 | 28.04       | 44.93 | 3.39        | 44.65 |                  |
| Got work under MGNREGA                 | 25.21        | 43.48 | 38.93       | 48.77 | 13.71***     | 48.20 |                  |
| Have access to Kisan Credit Card       | 18.34        | 38.75 | 14.70       | 35.42 | −3.64        | 36.01 |                  |
| Opened account under JDY program       | 23.78        | 42.63 | 35.24       | 47.78 | 11.46***     | 47.15 |                  |
| Household with at least one member with above 60 years old | 48.14 | 50.04 | 39.10       | 48.81 | −9.03**      | 49.12 |                  |
| Prevalence of food insecurity (moderate) rate–based on FAO global scale | 15.61 | 18.60 | 18.00       | 17.18 | 2.38*        | 17.60 | 17.44 |

(Continues)
The Table reveals that non-beneficiary households (those who did not receive PMGKY subsidies) were less worried about food (48%). When queried about the consumption of healthy food, the Table shows that non-beneficiary families had consumed less “healthy” foods (59%) compared to beneficiary households (69%). Table 2 shows mixed responses along the food insecurity scale for the beneficiary and nonbeneficiary households. For instance, a greater share of nonbeneficiary families skipped meals (9%), ran out of food (9%), went hungry (8%), and skipped meals for a day (5%), compared with beneficiary households. Table 2 also shows significant variation in food insecurity questions among beneficiary and nonbeneficiary households and states. For instance, more rural households living in West Bengal and Odisha are food insecure than rural families living in eastern UP and Bihar. Table 2 fails to address the prevalence of food insecurity among rural families in the above states. We calculated the prevalence of food insecurity using the Rasch Model to address that problem.

### 4.1 State-wise prevalence of food insecurity across caste and land sizes

In this study, we use the Rasch model to estimate the prevalence of food insecurity. Household caste classification and land size play a critical role in any social development programs in eastern India. Tables 3 and 4 present the prevalence of food insecurity by social classification by caste and land size, respectively. About 18% and 0.67% of rural households in eastern India are “moderately” and “severely” food insecure, respectively (Table 3). In our sample, non-beneficiary households are less food insecure (moderate) than beneficiary households because nonbeneficiary households are better off in education, social caste, and land size. But on the contrary, nonbeneficiary households are more food insecure (severe) than beneficiary households, which reflects that government/social programs (especially subsidized food grains) are reaching out to the poor people and making them less severe. When comparing states, Table 3 shows that in the moderate category, families from Odisha have a higher incidence (30.30%) of food insecurity, followed by West Bengal (15.26%), Jharkhand (14.90%), Bihar (14.81%), and Eastern UP (14.77%). For the severe category, households from West Bengal have the highest incidence of food insecurity (1.06%), followed by Bihar (0.66%), Eastern UP (0.50%), Jharkhand (0.41%), and Odisha (0.39%). Among social caste classes, Table 3 shows that in the moderate category, STs (24.00%) are most susceptible to food insecurity, followed by SCs (19.28%), OBCs (17.93%), and general caste (12.94%). But the scenario is quite

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**Table 1 (Continued)**

| Variables | Nonbeneficiary (N = 349) | PMGKY beneficiary (N = 1762) | Overall (N = 2111) |
|-----------|--------------------------|-----------------------------|---------------------|
|           | Mean | SD | Mean | SD | Diff | Mean | SD |

Prevalence of food insecurity (severe) rate-based on FAO global scale

1.11 3.55 0.59 2.49 −0.52** 0.67 2.70

**Abbreviations:** MGNREGA, Mahatma Gandhi Employment Guarantee Act; PMGKY, Pradhan Mantri Garib Kalyan Yojana; SD, standard deviation.

1Sample covered 2599 households. Here we have included only those observations who had National Food Security Act (NFSA) card and eligible for the PMGKY program. We further dropped some observations due to missing responses in Food Insecurity Experience Scale (FIES) indicators.

14We calculated the Rasch score using R software's "RM.weights" and the FAO-VoH global scale.
TABLE 2 State-wise status comparison of indicators of food insecurity (%), India, 2020.

| Questions | A | B | C | D | E | F | G | H |
|-----------|---|---|---|---|---|---|---|---|
| States    | Worried<sup>a</sup> | Healthy<sup>b</sup> | Few foods<sup>c</sup> | Skipped<sup>d</sup> | Ate less<sup>e</sup> | Ran out<sup>f</sup> | Hungry<sup>g</sup> | Whole day<sup>h</sup> |
| Non-PMGKY beneficiary | | | | | | | | |
| Bihar     | 37.2 | 48.7 | 35.3 | 8.3 | 10.9 | 7.7 | 5.1 | 5.1 |
| Eastern UP | 11.8 | 47.1 | 38.2 | 5.9 | 5.9 | 5.9 | 2.9 | 2.9 |
| Jharkhand | 46.7 | 46.7 | 53.3 | 20.0 | 13.3 | 20.0 | 13.3 | 6.7 |
| Odisha    | 71.0 | 58.1 | 67.7 | 3.2 | 61.3 | 6.5 | 3.2 | 3.2 |
| West Bengal | 67.3 | 77.9 | 25.7 | 10.6 | 22.1 | 11.5 | 14.2 | 5.3 |
| Eastern India | 47.9 | 58.7 | 36.1 | 8.9 | 18.6 | 9.2 | 8.0 | 4.9 |
| PMGKY beneficiary | | | | | | | | |
| Bihar     | 41.9 | 60.5 | 47.1 | 7.2 | 13.2 | 10.8 | 3.4 | 1.9 |
| Eastern UP | 38.1 | 66.5 | 43.5 | 9.1 | 12.7 | 3.0 | 3.0 | 2.7 |
| Jharkhand | 34.8 | 52.7 | 42.8 | 6.0 | 10.5 | 11.4 | 1.0 | 1.0 |
| Odisha    | 94.9 | 97.3 | 88.0 | 2.1 | 77.1 | 0.6 | 2.7 | 0.3 |
| West Bengal | 62.3 | 65.2 | 27.5 | 9.4 | 25.6 | 7.9 | 8.5 | 2.9 |
| Eastern India | 55.9 | 69.0 | 48.3 | 7.0 | 28.2 | 6.7 | 4.3 | 1.9 |
| Overall   | | | | | | | | |
| Bihar     | 40.6 | 57.3 | 43.9 | 7.5 | 12.5 | 9.9 | 3.8 | 2.8 |
| Eastern UP | 35.6 | 64.7 | 43.0 | 8.8 | 12.1 | 3.3 | 3.0 | 2.7 |
| Jharkhand | 35.6 | 52.3 | 43.5 | 6.9 | 10.6 | 12.0 | 1.9 | 1.4 |
| Odisha    | 92.8 | 93.9 | 86.2 | 2.2 | 75.8 | 1.1 | 2.8 | 0.6 |
| West Bengal | 63.2 | 67.6 | 27.2 | 9.6 | 25.0 | 8.6 | 9.6 | 3.4 |
| Eastern India | 54.6 | 67.3 | 46.3 | 7.3 | 26.6 | 7.1 | 4.9 | 2.4 |

<sup>a</sup>During the last 1 month, was there a time when you were worried you would not have enough food to eat because of a lack of money or other resources?

<sup>b</sup>Still thinking about the last 1 month, was there a time when you were unable to eat healthy and nutritious food because of a lack of money or other resources?

<sup>c</sup>Was there a time when you ate only a few kinds of foods because of a lack of money or other resources?

<sup>d</sup>Was there a time when you had to skip a meal because there was not enough money or other resources to get food?

<sup>e</sup>Still thinking about the last 1 month, was there a time when you ate less than you thought you should because of a lack of money or other resources?

<sup>f</sup>Was there a time when your household ran out of food because of a lack of money or other resources?

<sup>g</sup>Was there a time when you were hungry but did not eat because there was not enough money or other resources for food?

<sup>h</sup>During the last 1 month, was there a time when you went without eating for a whole day because of a lack of money or other resources?

different in the case of the severe category. Table 3 shows that SCs (0.75%) are most susceptible followed by OBCs (0.74%), STs (0.52%), and general caste (0.51%). Table 3 shows that the prevalence of food insecurity differs by state and social classes of the beneficiary and nonbeneficiary rural families. Overall, the moderate food insecurity status of nonbeneficiary households is relatively better than that of beneficiary households. However, beneficiary
households are better off than nonbeneficiary rural families regarding severe food insecurity. Thus, one can conclude that the PMGKY program was more beneficial for rural households with severe food insecurity. However, we will conduct a more detailed assessment of the PMGKY program’s efficacy using advanced econometric tools in the next section.

Table 4 reveals the prevalence of food insecurity by land size. About 21% of landless households were facing moderate food insecurity, followed by small farmers (17.93%), marginal farmers (16.25%), and medium and large (11.38%) farmers. In terms of the state-wise prevalence of food insecurity, Table 4 reveals that landless households from Odisha (31.14%) are most susceptible, followed by Jharkhand (20.64%), eastern UP (17.74%), eastern India (17.33%), and Bihar (16.59%). Severe food insecurity is more prevalent among landless households from West Bengal (1.78%), followed by Bihar (0.99%), Jharkhand (0.90%), and Eastern UP (0.74%), and Odisha (0.72%). Comparing beneficiary and nonbeneficiary households in the moderate category, Table 4 shows that landless farmers are more food insecure, followed by small, marginal, and medium and large farmers. But, in nonbeneficiary families, small farmers (1–2 ha) are more food insecure than marginal farmers (less than 1 ha). Overall, food

|                | Moderate |       |       |       |       |       |       |       |
|----------------|----------|-------|-------|-------|-------|-------|-------|-------|
|                | SC  | ST  | OBC | General | All | SC  | ST  | OBC | General | All |
| Non-PMGKY beneficiary |       |       |       |       |       |       |       |       |
| Bihar          | 23.97 | 25.56 | 16.70 | 5.41 | 12.86 | 0.38 | 3.80 | 1.59 | 0.02 | 0.94 |
| Eastern UP     | 18.89 | 0.00  | 14.53 | 10.89 | 13.41 | 0.24 | 0.00 | 1.41 | 0.00 | 0.55 |
| Jharkhand      | 28.64 | 21.95 | 14.37 | 33.79 | 18.64 | 0.00 | 0.86 | 2.39 | 0.00 | 1.66 |
| Odisha         | 44.21 | 31.13 | 28.08 | 12.88 | 26.93 | 4.77 | 0.08 | 0.08 | 0.03 | 0.67 |
| West Bengal    | 16.08 | 0.00  | 23.04 | 15.25 | 16.57 | 1.36 | 0.00 | 2.26 | 1.47 | 1.55 |
| Eastern India  | 20.33 | 25.51 | 18.40 | 10.60 | 15.61 | 1.22 | 1.72 | 1.58 | 0.62 | 1.11 |
| PMGKY beneficiary |       |       |       |       |       |       |       |       |
| Bihar          | 19.39 | 21.16 | 14.43 | 12.46 | 15.54 | 0.75 | 0.36 | 0.51 | 0.46 | 0.56 |
| Eastern UP     | 16.04 | 0.00  | 15.04 | 11.89 | 14.91 | 0.60 | 0.00 | 0.55 | 0.03 | 0.50 |
| Jharkhand      | 16.43 | 19.62 | 13.30 | 10.38 | 14.62 | 0.06 | 0.57 | 0.33 | 0.00 | 0.31 |
| Odisha         | 30.91 | 29.73 | 30.82 | 31.12 | 30.62 | 0.80 | 0.09 | 0.26 | 0.07 | 0.37 |
| West Bengal    | 14.43 | 14.07 | 21.69 | 12.99 | 14.95 | 0.76 | 0.87 | 2.18 | 0.65 | 0.94 |
| Eastern India  | 19.16 | 23.80 | 17.86 | 14.01 | 18.00 | 0.70 | 0.36 | 0.61 | 0.46 | 0.59 |
| Overall        |       |       |       |       |       |       |       |       |
| Bihar          | 19.86 | 23.36 | 14.93 | 8.71  | 14.81 | 0.71 | 2.08 | 0.75 | 0.23 | 0.66 |
| Eastern UP     | 16.10 | 0.00  | 15.01 | 11.63 | 14.77 | 0.57 | 0.00 | 0.60 | 0.02 | 0.50 |
| Jharkhand      | 16.92 | 19.84 | 13.37 | 11.68 | 14.90 | 0.05 | 0.59 | 0.47 | 0.00 | 0.41 |
| Odisha         | 31.43 | 29.85 | 30.59 | 26.83 | 30.30 | 0.95 | 0.09 | 0.25 | 0.06 | 0.39 |
| West Bengal    | 14.65 | 13.54 | 21.96 | 13.55 | 15.26 | 0.84 | 0.84 | 2.19 | 0.85 | 1.06 |
| Eastern India  | 19.28 | 24.00 | 17.93 | 12.94 | 17.60 | 0.75 | 0.52 | 0.74 | 0.51 | 0.67 |

Abbreviations: General, all other castes, excluding SC, ST, and OBC; OBC, Other Backward Class; PMGKY, Pradhan Mantri Garib Kalyan Yojana; SC, Scheduled Castes; ST, Scheduled Tribes.
insecurity is relatively less prevalent among landholding households than among landless families, which appear to be more susceptible to moderate and severe food insecurity.

5 | EMPIRICAL FRAMEWORK

Several matching methods have been used in the literature, including propensity scoring matching. However, PSM and similar approaches belong to a class of matching methods that reduce bias by an equal percentage and do not ensure any imbalance reduction in a given data—posing significant problems for researchers. Another drawback of the matching method is that the treatment selection is based on the observed covariates. If any unobserved factors

### Table 4

State-wise prevalence of moderate and severe food insecurity rate across landholding classes, India, 2020.

|               | Moderate |                | Severe |                |
|---------------|----------|----------------|--------|----------------|
|               | Land class |                | Land class |                |
|               | Landless | Marginal | Small & large | All | Landless | Marginal | Small & large | All |
| Non-PMGKY Beneficiary |          |          |          |          |          |          |          |          |
| Bihar         | 17.85    | 14.32    | 10.68    | 3.66    | 12.86    | 2.02     | 1.09    | 0.28    | 0.00    | 0.94 |
| Eastern UP    | 21.60    | 13.09    | 10.77    | 10.85   | 13.41    | 3.15     | 0.19    | 0.00    | 0.00    | 0.55 |
| Jharkhand     | 35.81    | 11.39    | 33.79    | 0.00    | 18.64    | 4.09     | 0.96    | 0.00    | 0.00    | 1.66 |
| Odisha        | 33.80    | 21.59    | 27.31    | 20.81   | 26.93    | 1.73     | 0.26    | 0.08    | 0.06    | 0.67 |
| West Bengal   | 23.05    | 15.98    | 2.09     | 6.26    | 16.57    | 2.64     | 1.38    | 0.00    | 0.00    | 1.55 |
| Eastern India | 23.36    | 15.16    | 12.63    | 7.23    | 15.61    | 2.40     | 1.09    | 0.19    | 0.01    | 1.11 |
| PMGKY beneficiary |        |          |          |          |          |          |          |          |
| Bihar         | 16.30    | 15.62    | 17.10    | 10.10   | 15.54    | 0.76     | 0.45    | 0.95    | 0.05    | 0.56 |
| Eastern UP    | 16.51    | 15.06    | 11.19    | 10.57   | 14.91    | 0.61     | 0.56    | 0.01    | 0.00    | 0.50 |
| Jharkhand     | 19.26    | 12.61    | 16.92    | 9.00    | 14.62    | 0.61     | 0.29    | 0.13    | 0.01    | 0.31 |
| Odisha        | 30.97    | 30.13    | 31.16    | 28.33   | 30.62    | 0.65     | 0.15    | 0.08    | 0.06    | 0.37 |
| West Bengal   | 16.63    | 14.64    | 8.17     | 0.00    | 14.95    | 1.61     | 0.76    | 0.02    | 0.00    | 0.94 |
| Eastern India | 21.03    | 16.46    | 19.42    | 13.29   | 18.00    | 0.88     | 0.53    | 0.32    | 0.04    | 0.59 |
| Overall       |          |          |          |          |          |          |          |          |
| Bihar         | 16.59    | 15.27    | 14.68    | 7.91    | 14.81    | 0.99     | 0.62    | 0.70    | 0.03    | 0.66 |
| Eastern UP    | 16.77    | 14.92    | 11.13    | 10.69   | 14.77    | 0.74     | 0.54    | 0.01    | 0.00    | 0.50 |
| Jharkhand     | 20.64    | 12.51    | 17.38    | 8.30    | 14.90    | 0.90     | 0.34    | 0.13    | 0.01    | 0.41 |
| Odisha        | 31.14    | 29.43    | 30.67    | 26.92   | 30.30    | 0.72     | 0.16    | 0.08    | 0.06    | 0.39 |
| West Bengal   | 17.74    | 14.89    | 6.14     | 6.26    | 15.26    | 1.78     | 0.87    | 0.01    | 0.00    | 1.06 |
| Eastern India | 21.30    | 16.25    | 17.93    | 11.38   | 17.60    | 1.05     | 0.62    | 0.30    | 0.03    | 0.67 |

Note: Marginal (<1 ha); small (1–2 ha); medium and large (>2 ha).

Abbreviation: PMGKY, Pradhan Mantri Garib Kalyan Yojana.
that influence the treatment are omitted, the treatment’s impact on outcomes is likely biased. However, the instrumental variable (IV) approach takes care of the issues related to unobserved factors as long as we use a valid instrument variable (explained later in this section). Therefore, the present study uses Lewbel’s instrumental variable (IV) approach to estimate the impact of the treatment (receiving benefits under PMGKY) on the food insecurity measures (moderate and severe). Specifically, Equation (2) estimates the effects of PMGKY participation on moderate and severe food insecurity,

\[ Y_{ij} = \alpha + \beta_i \text{PMGKY} + \gamma_i + \varepsilon_{ij}, \]

where \( Y \) denotes a column vector of the dependent variable (moderate and severe food insecurity scale). \( \text{PMGKY} \) is a dummy variable that takes the value of 1 if a household is a beneficiary and 0; otherwise, \( X \) is a vector of control variables, and \( \varepsilon \) is an error term with a mean of zero. If \( \text{PMGKY} \) is exogenous to the outcome variables, then the coefficient \( \beta_i \) represents the average treatment effects on the dependent variable of interest. However, beneficiary households cannot be assigned randomly, and there may be omitted variables that are likely to influence the beneficiary and the dependent variable. For example, omitted variables related to skills and information access (e.g., access to information related to central and state government programs, exposure to several programs conducted by the government, and association with local leaders, etc.) are likely to influence both treatments (receiving benefits under PMGKY) and outcome variables (moderate and severe food insecurity). In our case, the endogeneity problem is possible due to omitted variable bias rather than simultaneous causality.

The identification strategy relies on the use of instrumental variables. There are two critical assumptions of the IV method. First, the instruments should be correlated with the endogenous (treatment) variable. Small values (<10) of first-stage F-statistics imply failure of the first assumption. The null hypothesis that the PMGKY is exogenous was rejected (at the 1% level of significance). Second, the instruments must be uncorrelated with the error and can be tested with more instruments than treatments. For the identification strategy, we have used “availability of power supply in the village in summer and winter season” We call this a proxy variable for governance functioning at the village level. Round-the-clock availability of power in a village reflects prosperity and better governance. Similarly, the uptake of PMGKY beneficiaries depends entirely on the village level’s functioning of administration/governance. This instrumental variable establishes the causal relationship between PMGKY and outcome indicators. Thus, the identifying assumption is that the instrumental variable is uncorrelated with \( \varepsilon \) in Equation (3).

\[ Y_{2i} = \alpha_2 + \beta_{2i} \text{PMGKY} + \gamma_2 + \varepsilon_{2i} \]

where \( \beta_{2i} \) is the predicted value of \( \text{PMGKY} \) obtained from the first-stage regression of \( \text{PMGKY} \) on instrumental variables and all the control variables \( (X) \) in Equation (4) can be shown below:

\[ \text{PMGKY} = \alpha_3 + \beta_2 Z + \gamma_3 X + \varepsilon, \]

where \( Z \) is the instrumental variable (IV) that reflects the efficiency of the governance structure at the village level, and \( \varepsilon \) is an error term with a mean zero. If the instrument \( (Z) \) is valid, then the coefficient \( \beta_{2i} \) is the main effect (e.g., local average treatment effects [LATE]) of PMGKY on the outcome variable). Furthermore, the standard IV regression assumes that the instrumental variables are not correlated with the error term. Thus, we get the presence of heteroscedasticity in the standard IV assumption, resulting in an inefficient outcome. Hence, in this study, we use Lewbel’s IV approach. Lewbel’s (2012) technique solves the heteroscedasticity problem by generating instrumental variables from the data that are not correlated with the heteroscedastic error. The procedure produces three sets of estimates: (i) estimates based on standard IVs, (ii) estimates based on generated IVs, and (iii) estimates based on both standard IVs and generated IVs. In this method, instruments are produced as simple functions from the model’s data. The estimators customarily use appropriate lagged values of endogenous regressors to identify the model (Lewbel, 2012). This study presents all four estimates from Lewbel’s method. We check for the instrument’s strength in the first stage by including it in the regression of beneficiary of PMGKY on its determinants.
and provided first stage estimates in Appendix Table A2. Appendix Table A2, both instrumental variables are statistically significant and strongly correlated with the treatment variable. We argue that it is not systematically related to the outcome variable (i.e., moderate and severe food insecurity). Thus, the variables meet the required conditions for an instrument.

5.1 Validation of instruments

Our analysis considered the “availability of power supply in the village in summer and winter season” as an instrumental variable. We call this a proxy variable for governance functioning at the village level. Round-the-clock availability of power in a village reflects prosperity and better governance. In Equation (4), an assumption on IV requires that the variables in Z be uncorrelated with the covariance between error terms in the treatment and outcome variable. The availability of power supply in the village in the summer and winter is expected to serve as an instrument because of the better performance of government machinery at the ground level, and outreach of the PMGKY program is likely to reach all eligible households in the village. If neighbors obtain electricity in both seasons, then a village with less power availability would signal low socioeconomic standing and the reflecting lack of government machinery mechanism. The exclusion restriction for our instrument is that the variation in power supply across villages and the infrastructure of power set up had cumulated over a decade and not from specific events around the year. Another dynamic would be government/local administration spent on power infrastructure, which would depend on the government machinery's functioning, the role of local leaders, and proximity of the village from the town. In contrast, a vast body of literature on peer effects and other valid instruments (such as Akerlof & Kranton, 2002; Munshi & Myaux, 2006) found that peer and neighbor effects in the context of school decision. Bandiera and Rasul (2006) focused on the impact of social networks on the technology of adoption in Mozambique. Kumar et al. (2018) showed the effect of general caste in choosing dairy cooperatives.

However, it is often tricky to establish an assumption on the validity of an instrument in terms of exclusion restriction. If the assumption does not hold, IV estimates will be inconsistent. To overcome this challenge, we use the technical instruments provided by Lewbel (2012). The Lewbel approach uses data-driven technical instruments to obviate inconsistencies in IV estimates arising from possibly invalid instruments. The heteroscedasticity-based identification relies on heteroscedasticity working as a probabilistic shifter, an essential idea in tracing a causal relationship via exclusion restrictions. Practically, this method involves constructing instruments as simple functions of the model’s data and validating instrumental variables in Appendix Table A3.

6 RESULTS AND DISCUSSIONS

Table 5 shows the parameter estimates obtained from the probit and OLS model for factors affecting the PMGKY cash transfer program participation. Results in Table 5 indicate that the coefficient of the age of the head of household (HH) is negative and statistically significant at the 1% level. Findings suggest that an additional year decreases the likelihood of participation in the PMGKY cash transfer program by 0.1% (Table 5, column 4). A plausible explanation is that older HHs tend to have more diversified income sources and more assets that could be used to smooth consumption during the pandemic period. As expected, the family size coefficient (household size) is positive and statistically significant at the 5% level. Findings suggest that an additional member increases the likelihood of participation in the PMGKY cash transfer program by 0.7% (Table 5, column 4).

Generally, low-income households have more family members, and these families tend to live on a daily wage income. Under the extraordinary circumstances of the COVID-19 crisis, these households are likely to be significantly affected by the pandemic’s negative impact on private sector revenue and employee livelihood; thus, they have depended on PMGKY for cash income. The results in Table 5 show that educational attainment has a
negative and significant effect on participation in the PMGKY program. Compared to illiterate HHs, educated HHs with high school or higher education levels are less likely to participate in the PMGKY cash transfer program. However, the marginal effect (column 4, Table 5) is higher for HHs with a college education; those who were college-educated, for instance, were 13% less likely to participate in the program. Our finding is consistent with Raghunathan et al. (2017), who argued that educated households are less likely to depend on government programs that provide inferior quality services and goods.

Social identity in the context of India is anchored by a person’s social class or caste. Lower castes have higher poverty rates, are less connected, have inadequate access to credit, lack information about modern

### TABLE 5
Factors affecting rural Indian households participation in PMGKY program (Probit and OLS models), India.

| Variables                                | Probit model | OLS       |
|------------------------------------------|--------------|-----------|
|                                          | (1)          |           |
|                                          | Col | 2   | 3   | 4   | 5   | 6   | 7   |
| Age of household head (in years)         | −0.008**     | −0.001*** | −0.001** |
| Household size (nos)                     | 0.037**      | 0.007**   | 0.007** |
| Education (Base: Illiterate)             |              |           |       |
| Up to Primary                            | −0.173       | −0.032    | −0.030* |
| High school                              | −0.523***    | −0.095*** | −0.096*** |
| Secondary                                | −0.383***    | −0.070*** | −0.067*** |
| Graduation and above                     | −0.721***    | −0.131*** | −0.149*** |
| Caste (Base: OBC)                        |              |           |       |
| Scheduled Castes                         | 0.253*       | 0.046*    | 0.030 |
| Scheduled Tribes                         | −0.276       | −0.050    | −0.041 |
| General                                  | −0.430***    | −0.078*** | −0.121*** |
| Landholding category (Base: Landless)    |              |           |       |
| Marginal                                 | 0.003        | 0.001     | −0.001 |
| Small                                    | −0.277*      | −0.050*   | −0.054* |
| Medium and Large                         | −0.457**     | −0.083**  | −0.110** |
| Share of nonfarm income (%)              | −0.001       | −0.000    | −0.000 |
| Access to credit                         | 0.105        | 0.019     | 0.018 |
| Migrant member                           | 0.173*       | 0.031*    | 0.028 |
| Have KCC                                 | −0.102       | −0.019    | −0.017 |
| Constant                                 | 1.385***     |          | 1.088*** |
| District fixed effect                    | Yes          | Yes       | Yes    |
| Observations                             | 2038         | 2038      | 2103   |
| R-squared                                | 0.150        |           |        |

Note: Robust standard errors in parentheses, ***p < 0.01, **p < 0.05, *p < 0.1, clustering at village level.
Abbreviations: KCC, Kisan Credit Card; OBC, Other Backward Caste; OLS, ordinary least-squares; PMGKY, Pradhan Mantri Garib Kalyan Yojana.
technologies, and face disadvantages. Results in Table 5 indicate that the coefficients of Scheduled Castes (SC) and general castes are positive and negative, respectively, and statistically significant at the 10% and 1% levels. Findings suggest that families belonging to the SC class are 4.6% more likely than families belonging to Other Backward Castes (OBC) to participate in the PMGKY cash transfer program. Compared with families belonging to OBC, families belonging to general castes are about 8% less likely to participate. The above finding is not surprising as families belonging to lower castes (SCs and STs) have higher poverty rates, are less connected, have inadequate access to credit, (Kumar et al., 2020), lack information about modern technologies, and face other disadvantages. A plausible explanation could be that family members of lower castes (SCs) are employed in the casual labor market and earn significantly lower wages than members of upper castes (Ito, 2009). The pandemic has dramatically disrupted the informal labor market and thus SC families' livelihoods.

Results in Table 5 show that compared with landless farm families, families with small (1–2 ha) and medium and large (>2 ha) landholdings are less likely, 5% and 8%, respectively, to participate in the PMGKY cash transfer program. Families who own and operate farms of a hectare or more can support food and consumption expenditures more than cash transfer programs. Landholding may also be a proxy for wealth, and as a result, relatively wealthy families are less likely to participate in government-sponsored programs. Our finding is consistent with Magaña-Lemus and Lara-Álvarez (2015) and Temple (2016). Additionally, our result is consistent with Magaña-Lemus et al. (2016), who found that agricultural households were less likely to be either moderately or severely food insecure. Finally, Table 5 indicates that the coefficient of the migrant member is positive and statistically significant at the 10% level. Findings suggest that families with at least one member who is a migrant worker are more likely (3%) to participate in the PMGKY cash transfer program. That result is consistent with migration and income diversification studies—members migrate to urban areas to increase income and diversify household income sources (see Barrett et al., 2001; Otsuka & Yamano, 2006; Reardon et al., 1988). When the pandemic brought Indian cities to a standstill and shut down the global economy, many migrants may have lost their livelihoods and incomes and returned to their rural families.

Table 6 reports the estimates of participation in PMGKY and its impact on the intensity of food insecurity (moderate and severe). The left panel of Table 6 (columns 1–4) reports estimates for moderate food insecurity, while the right panel (columns 5–8) reports estimates for severe food insecurity using the OLS and Lewbel IV model. Note that the coefficients of PMGKY in the OLS model (columns 1 and 5) are insignificant for moderate and severe food insecurity outcomes. However, these estimates could be biased and are not controlled by omitted variables. In contrast, the parameter estimates of the PMGKY variable obtained from the Lewbel IV are statistically significant and vary across different methods under the Lewbel IV method. Regarding moderate food insecurity, the coefficient on PMGKY (columns 2–4, Table 6) is negative and statistically significant (between −2.9 and −2.4). For instance, the result shows that participation in the PMGKY government transfer program decreases the prevalence of moderate food insecurity in rural households by about 2.4% (see columns 3–4).

On the other hand, the coefficient on PMGKY (columns 6–8, Table 6) is negative and statistically significant (between −0.99 and −0.85) at the 1% level of significance. For instance, the result shows that participation in PMGKY decreases the prevalence of severe food insecurity in rural households by about 0.92% (see columns 6–7, the average value of 0.99 and 0.85). Indeed, this study’s findings suggest that government cash transfers during the COVID crisis were instrumental in significantly reducing food insecurity in rural Indian households. Our result is consistent with findings from several cash transfer

15The Caste system is comprised of four hierarchical categories, the Brahmins, Kshatriyas, Vaishyas, and Shudras. These castes are classified as Scheduled Castes (SC’s), the socially and economically marginalized, indigenous ethnic groups that are classified as Scheduled Tribes (ST’s), and, more recently, another group of castes, which are referred to as Other Backward Castes (OBC’s).
## Impact of PMGKY on the prevalence of moderate and severe food insecurity—Lewbel IV method.

|                | Moderate food insecurity |            |            | Severe food insecurity |            |            |
|----------------|--------------------------|------------|------------|------------------------|------------|------------|
|                | OLS 1                    | Standard IV 2 | Generated IV 3 | Standard and Generated IV 4 | OLS 5 | Standard IV 6 | Generated IV 7 | Standard and Generated IV 8 |
| Treatment variable: (PMGKY = 1; otherwise = 0) | -18.274 | -2.927** | -2.400* | -2.414* | -10.061 | -0.988*** | -0.845*** | -0.848*** |
|                | (41.753)                | (1.332) | (1.368) | (1.367) | (8.526) | (0.304) | (0.305) | (0.304) |
| Age of household head | -0.020 | -0.034 | -0.035 | -0.035 | -0.001 | -0.009 | -0.009 | -0.009 |
|                | (0.058)                 | (0.040) | (0.040) | (0.040) | (0.015) | (0.008) | (0.008) | (0.008) |
| Household size (nos) | 0.053 | -0.034 | -0.037 | -0.037 | 0.070 | 0.019 | 0.018 | 0.018 |
|                | (0.286)                 | (0.144) | (0.141) | (0.141) | (0.064) | (0.028) | (0.028) | (0.028) |
| Education (in years) | -0.206 | -0.117 | -0.114 | -0.114 | -0.056 | -0.003 | -0.002 | -0.002 |
|                | (0.259)                 | (0.085) | (0.083) | (0.083) | (0.055) | (0.016) | (0.015) | (0.015) |
| Scheduled caste | 1.225 | 0.793 | 0.778 | 0.779 | 0.241 | -0.014 | -0.018 | -0.018 |
|                | (1.570)                 | (1.080) | (1.061) | (1.061) | (0.368) | (0.223) | (0.218) | (0.218) |
| Scheduled tribes | -0.890 | -0.249 | -0.227 | -0.228 | -0.443 | -0.064 | -0.058 | -0.059 |
|                | (2.368)                 | (1.421) | (1.397) | (1.397) | (0.591) | (0.293) | (0.288) | (0.288) |
| General caste | -2.805 | -1.127 | -1.069 | -1.071 | -1.339 | -0.347 | -0.331 | -0.332 |
|                | (4.817)                 | (1.192) | (1.163) | (1.164) | (1.048) | (0.213) | (0.208) | (0.208) |
| Land size (in ha) | -1.826 | -1.281*** | -1.263*** | -1.263*** | -0.557* | -0.234*** | -0.229*** | -0.229*** |
|                | (1.572)                 | (0.394) | (0.387) | (0.387) | (0.335) | (0.059) | (0.058) | (0.058) |
| Nonfarm income (%) | -0.013 | -0.008 | -0.008 | -0.008 | -0.003 | 0.000 | 0.000 | 0.000 |
|                | (0.023)                 | (0.016) | (0.016) | (0.016) | (0.006) | (0.003) | (0.003) | (0.003) |
|                          | Moderate food insecurity | Severe food insecurity |
|--------------------------|--------------------------|------------------------|
|                          | OLS 1        | Standard IV 2         | Generated IV 3   | Standard and Generated IV 4 | OLS 5        | Standard IV 6         | Generated IV 7 | Standard and Generated IV 8 |
| Have KCC                 | -1.661       | -1.146                | -1.129           | -1.129                   | -0.204       | 0.101                 | 0.106            | 0.105                     |
|                          | (1.806)      | (1.104)               | (1.087)          | (1.087)                  | (0.417)      | (0.214)               | (0.211)          | (0.211)                   |
| Migrant member           | 0.548        | 0.643                 | 0.646            | 0.646                    | -0.073       | -0.017                | -0.016           | -0.016                    |
|                          | (1.045)      | (0.959)               | (0.942)          | (0.942)                  | (0.288)      | (0.187)               | (0.183)          | (0.183)                   |
| Member > 60 age          | -0.671       | -0.279                | -0.266           | -0.266                   | -0.355       | -0.124                | -0.120           | -0.120                    |
|                          | (1.553)      | (0.962)               | (0.946)          | (0.946)                  | (0.372)      | (0.190)               | (0.187)          | (0.187)                   |
| Constant                 | 37.398       | 31.030***             | 21.882***        | 21.896***                | 11.158       | 1.422**               | 2.149**          | 2.153***                  |
|                          | (40.496)     | (4.056)               | (3.481)          | (3.480)                  | (8.251)      | (0.562)               | (0.677)          | (0.677)                   |
| Instrumental Variable    | No           | Yes                   | Yes              | Yes                      | No           | Yes                   | Yes              | Yes                       |
| Block fixed effect       | Yes          | Yes                   | Yes              | Yes                      | Yes          | Yes                   | Yes              | Yes                       |
| Observations             | 2110         | 2110                  | 2110             | 2110                     | 2110         | 2110                  | 2110             | 2110                      |
| R-squared                | 0.375        | 0.295                 | 0.375            | 0.375                    | 0.107        | 0.096                 | 0.107            | 0.107                     |

Note: Robust standard errors in parentheses.

Abbreviations: KCC, Kisan Credit Card; OLS, ordinary least-squares; PMGKY, Pradhan Mantri Garib Kalyan Yojana.

***p < 0.01.

**p < 0.05.

* p < 0.1.
programs (similar to PMGKY) that positively impact diet quality or improvement in economic vulnerability to food insecurity (Brugh et al., 2018; Ruiz-Arranz et al., 2002). Finally, our finding is consistent with Akbar et al. (2020), who found that the Benazir Income Support Program in Pakistan reduced severe food insecurity in Pakistani households.

7 | CONCLUSIONS AND POLICY IMPLICATIONS

This article expands on the existing but scarce literature on the implementation of social protection programs and their impact on food (in)security. The prime objectives of this paper are to examine the status of food insecurity among rural households and to assess the effectiveness of PMGKY in mitigating food insecurity among rural Indians. The study collected information on food security from 2,599 rural households in eastern India from June–July 2020. The study employed the Rasch model to estimate the prevalence of food insecurity and the Lewbel IV method to evaluate the impact of the cash transfer program (PMGKY) on moderate and severe food insecurity among rural Indian households. The study found that the prevalence of food insecurity is significantly related to rural households' social classification (or caste) and landholding size. Farmers belonging to lower castes (STs and SCs) were more likely to be moderately or severely food insecure compared to households classified as OBCs and general castes. Food insecurity is not as prevalent among landholders as it is among landless Indians, and landless families are more likely to experience both moderate and severe food insecurity.

The study found that low-income, illiterate, lower-caste (SCs and STs), nonagricultural (landless) households, and households containing migrant workers are more likely to participate in the Indian government's cash transfer program (PMGKY). Additionally, the study found that the program has played a major role in reducing moderate and severe food insecurity among rural Indian households. For instance, in moderate food insecurity, the cash transfer program (PMGKY) reduced the prevalence of moderate food insecurity by 2.9% to 2.4%. In the case of severe food insecurity, estimates from our study revealed that the cash transfer program (PMGKY) reduced the prevalence of severe food insecurity in rural Indian households by about 0.92%.

The results from this study shed light on how government policies can effectively combat food insecurity challenges during national emergencies like pandemics. The ongoing COVID-19 pandemic dramatically disrupted the daily wage work that many rural households depended on for their income and livelihoods. Direct benefit transfers, such as PMGKY, to these vulnerable households, increase low-income families' consumption bundle and provide much-needed food security. Findings from this study underscore the importance of education in securing food and livelihood for many rural Indians. Policymakers need to invest in education and training programs that increase the income and livelihood security and food security of all Indians. Finally, policymakers must design policies and incentives to strengthen the nonfarm economy. A vibrant nonfarm economy may help provide stable jobs and incomes to migrant workers. Stable and increased revenues enhance food security not only for the migrant workers but also for rural families that depend on remittance income.

Overall, the PMGKY has played a critical role in mitigating food insecurity during India's COVID pandemic. Findings suggest that government cash transfers significantly reduced food insecurity in rural Indian households during the crisis. Indeed, this study's findings underscore Gundersen and Garasky's (2012) study that suggested improving households' finances is paramount in the fight against food insecurity. Consistent with other studies, this study showed that the PMGKY program directly impacts food security and effectively reduces economic vulnerability to food insecurity.
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APPENDIX A1: BRIEF BACKGROUND OF PMGYK
The Pradhan Mantri Garib Kalyan Yojana (PMGYK) is a comprehensive relief package for the poor to help them fight the battle against coronavirus. It was announced in March 2020 to reach out to the poorest of the poor, with food and money in hand, so that they do not face difficulties in buying essential supplies and meeting critical needs. This program is built upon 12 different programs already continued by the government. The PMGYK program uses several channels to support households under the National Food Security Act (NFSA), direct cash transfer, in-kind transfer, and insurance. The coverage of PMGYK was wide. The PMGYK used the National Social Assistance Program payment infrastructure to reach seniors, widowed, and disabled. The PMGYK used the PM-KISAN program to provide benefits to farmers. PMGYK transferred money to a female account holder with the PMJ DY program. The government used PMUY beneficiaries to pay for free cooking gas (LPG cylinders). The PMGYK provided free rations to National Food Security Act (NFSA) cardholders and benefits for organized sector workers earning Rs. 15,000 per month (Employees’ Provident Fund). The PMGYK increased the daily wage for MGNREGA participants. The PMGYK provided collateral-free loans to frontline workers under National Rural Livelihoods Mission (NRLM), monies for Self-Help Groups (SHG), and insurance. Tables A1–A3.
**TABLE A1**  Nutrition Indicators, selected states, and India.

| States          | Sector | Children under 5 years of age | Children age 6–59 months | All women age 15–49 years |
|----------------|--------|-------------------------------|--------------------------|--------------------------|
|                |        | Stunted (%) | Wasted (%) | Underweight (%) | Anemic (%) | Stunted (%) | Wasted (%) | Underweight (%) | Anemic (%) |
| Bihar          | Urban  | 36.8          | 21.6       | 35.8          | 67.9       | 65.6 |
|                | Rural  | 43.9          | 23.1       | 41.8          | 69.7       | 63.1 |
|                | Total  | 42.9          | 22.9       | 41.0          | 69.4       | 63.5 |
| Jharkhand      | Urban  | 26.8          | 23.0       | 30.0          | 65.5       | 61.1 |
|                | Rural  | 42.3          | 22.3       | 41.4          | 67.9       | 66.7 |
|                | Total  | 39.6          | 22.4       | 39.4          | 67.5       | 65.3 |
| Odisha         | Urban  | 24.9          | 14.9       | 21.5          | 56.2       | 61.5 |
|                | Rural  | 32.0          | 18.6       | 31.0          | 65.6       | 64.9 |
|                | Total  | 31.0          | 18.1       | 29.7          | 64.2       | 64.3 |
| West Bengal    | Urban  | 32.1          | 20.2       | 28.7          | 63.0       | 65.1 |
|                | Rural  | 34.4          | 20.4       | 33.5          | 71.3       | 74.4 |
|                | Total  | 33.8          | 20.3       | 32.2          | 69.0       | 71.4 |
| Uttar Pradesh  | Urban  | 33.0          | 18.7       | 28.2          | 65.3       | 50.1 |
|                | Rural  | 41.3          | 17.0       | 33.1          | 66.7       | 50.5 |
|                | Total  | 39.7          | 17.3       | 32.1          | 66.4       | 50.4 |
| India          | Urban  | 30.1          | 18.5       | 27.3          | 64.2       | 53.8 |
|                | Rural  | 37.3          | 19.5       | 33.8          | 68.3       | 58.5 |
|                | Total  | 35.5          | 19.3       | 32.1          | 67.1       | 57.0 |

*Source: National Family Health Survey-5, Ministry of Health and Family Welfare (MoHFW), Government of India.*

**TABLE A2**  First stage regression—Lewbel IV Method.

| Variables (dependent variable: 1 = beneficiary of PMGKY; 0 = otherwise) | Coef |
|-----------------------------------------------------------------------|------|
| Age of household head                                                 | 0.000 |
|                                                                      | (0.001) |
| Household size (nos)                                                  | 0.003 |
|                                                                      | (0.003) |
| Education (in years)                                                  | -0.006*** |
|                                                                      | (0.002) |
| Scheduled caste                                                       | 0.018 |
|                                                                      | (0.018) |
| Scheduled tribes                                                      | -0.020 |
|                                                                      | (0.029) |
| Variables (dependent variable: 1 = beneficiary of PMGKY; 0 = otherwise) | Coef         |
|---------------------------------------------------------------|-------------|
| General caste                                                | -0.180***   |
| (0.025)                                                       |             |
| Land size (in ha)                                             | -0.037***   |
| (0.011)                                                       |             |
| Nonfarm income (%)                                            | 0.000       |
| (0.000)                                                       |             |
| Have KCC                                                      | 0.013       |
| (0.023)                                                       |             |
| Migrant member                                               | -0.018      |
| (0.020)                                                       |             |
| Member > 60 age                                               | -0.023      |
| (0.021)                                                       |             |
| Instrumental variables                                        |             |
| Availability of power supply in summers in a day (hours)      | -0.012***   |
| (0.005)                                                       |             |
| Availability of power supply in winters in a day (hours)      | 0.013***    |
| (0.004)                                                       |             |
| Constant                                                     | 0.910       |
| (0.052)                                                       |             |
| Observations                                                 | 2110        |

**F test of excluded instruments**

\[ F (2, 2096) = 6.290 \]

\[ \text{Prob} > F = 0.002 \]

**Sanderson–Windmeijer multivariate F test of excluded instruments:**

\[ F (2, 2096) = 6.290 \]

\[ \text{Prob} > F = 0.002 \]

**Under identification test**

\[ \text{Sanderson–Windmeijer } \chi^2 \]

\[ p \text{ Value} = 0.002 \]

\[ \chi^2 \]

\[ p \text{ Value} = 0.002 \]

**Weak identification test**

\[ \text{Cragg–Donald Wald } F \text{ statistic} = 6.730 \]

\[ \text{Kleibergen–Paap Wald rk } F \text{ statistic} = 6.290 \]

(Continues)
TABLE A2  (Continued)

| Variables (dependent variable: 1 = beneficiary of PMGKY; 0 = otherwise) | Coef |
|---------------------------------------------------------------|------|

Weak-instrument-robust inference

| Anderson–Rubin Wald test | F (2,2096) | 18.170 |
|--------------------------|------------|--------|
|                          | p-value    | 0.000  |

Anderson–Rubin Wald test

| $\chi^2$ | 36.590 |
|----------|--------|
| p Value  | 0.000  |

Stock–Wright LM S statistic

| $\chi^2$ | 34.960 |
|----------|--------|
| p Value  | 0.000  |

Note: Robust standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1.
Abbreviations: KCC, Kisan Credit Card; PMGKY, Pradhan Mantri Garib Kalyan Yojana.
| Lewbel IV test                                                                 | Standard IV | Generated IV | Both standard and generated IV |
|-------------------------------------------------------------------------------|-------------|--------------|-------------------------------|
| Weak identification test (Cragg-Donald Wald F statistic):                    | 0.73        | 130.98       | 125.44                        |
| (Kleibergen–Paap rk Wald F statistic):                                       | 0.83        | 245.68       | 236.13                        |
| Stock–Yogo weak ID test critical values: 5% maximal IV relative bias         | 19.93       | 21.34        | 21.33                         |
| 10% maximal IV relative bias                                                 | 11.59       | 11.16        | 11.14                         |
| 20% maximal IV relative bias                                                 | 8.75        | 5.92         | 5.91                          |
| 30% maximal IV relative bias                                                 | 4.13        | 4.11         |                               |
| 10% maximal IV size                                                          |             | 121.98       | 126.75                        |
| 15% maximal IV size                                                          |             | 62.82        | 65.22                         |
| 20% maximal IV size                                                          |             | 42.81        | 44.42                         |
| 25% maximal IV size                                                          |             | 7.25         | 32.77                         |
| Hansen J statistic (overidentification test of all instruments):              | 0.08        | 37.58        | 41.55                         |
| $\chi^2(46)$ $p$ value                                                       | 0.77        | 0.74         | 0.66                          |
| -orthog- option:                                                              |             |              |                               |
| Hansen J statistic (eqn. excluding suspect orthog. conditions):              |             |              | 37.55                         |
| $\chi^2(44)$ $p$ value                                                       |             |              | 0.74                          |
| C statistic (exogeneity/orthogonality of suspect instruments):                |             |              | 4.00                          |
| $\chi^2(2)$ $p$ value                                                       |             |              | 0.14                          |