Government Transfers, COVID-19 Shock, and Food Insecurity: Evidence from Rural Households in India

by Anjani Kumar, Sunil Saroj, Ashok K. Mishra, and Shahidur Rashid

Government Transfers, COVID-19 Shock, and Food Insecurity: Evidence from Rural Households in India

Anjani Kumar[1]

Sunil Saroj[2]

Ashok K Mishra[3]

Shahidur Rashid[4]

Abstract

The COVID-19 pandemic has decimated the lives and livelihoods of people around the world. The impact of COVID-19 has been especially devastating for low-income families in rural areas of India. Food insecurity became pervasive in rural areas soon after the nationwide lockdown was announced, as many families relied on daily wage work to fund basic necessities. By providing cash transfers and the additional foodgrains, Indian policymakers acted swiftly to reduce the financial impact on family income and consumption. This paper investigates the factors affecting the participation of rural families in the cash transfer program and the effect of government cash transfers on food insecurity. Results indicate that the government cash transfer program in India decreased moderate food insecurity by 2.4% and severe food insecurity by about 0.92%.

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

JEL codes: O12, I31, I32, I38

[1] Senior Research Fellow in the South Asia Regional Office of the International Food Policy Research Institute,New Delhi, India. E-mail: anjani.kumar@cgiar.org

[2] Senior Research Analyst in the South Asia Regional Office of the International Food Policy Research Institute, New Delhi, India. E-mail: s.saroj@cgiar.org

[3] Professor at W. P. Carey School of Business, Kemper and Ethel Marley Foundation Chair in Food Management, Arizona State University, USA. E-mail: Ashok.K.Mishra@asu.edu

[4] Director of South Asia Regional Office of the International Food Policy Research Institute,New Delhi, India. E-mail: s.rashid@cgiar.org

1. Introduction

In early January 2020, the COVID-19 pandemic spread across the globe. Within months, it became perhaps the most significant global health crisis of our time—posing unprecedented humanitarian challenges and jeopardizing the food security of millions. Prior to the pandemic's arrival, 135 million people worldwide were already facing 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. The 2019 economic picture revealed a gross domestic product (GDP) growth rate of 4.7%, a moderate decline from 2018 (Trading Economics 2020), and the highest unemployment rate in 45 years (PLFS 2018–19). Furthermore, the nation's food security status was similarly precarious prior to the lockdown. India ranked 102 out of 117 countries in the 2019 Global Hunger Index (Grebmer et al. 2019). That ranking is worse than those of neighboring countries like Bangladesh, Nepal, and Pakistan, despite the fact that India's per-capita GDP, in purchasing-power-parity (PPP) terms, is significantly larger (World Bank 2020).

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 and is home to 93.5 million poor households.[5] The region is beleaguered by low per-capita income, low anthropometric parameters among inhabitants, and elevated food insecurity. Data from the National Family Health Survey (2015–16) reveal high incidences of stunting

[5] https://www.rbi.org.in/scripts/PublicationsView.aspx?id=16603

(39.3%), wasting (21.4%), underweight (39.3%), and anemia (58.4%) in children, adults men, and women throughout the region (see Table 1). Studies on malnutrition that have been conducted across India report severe levels of food insecurity in the eastern states. The data reveal 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, it announced the Pradhan Mantri Garib Kalyan Yojana (PMGKY) relief package of INR 1.7 lac crore (USD 25 billion). PMGKY initiatives focused primarily on supporting rural communities, poor people, wage workers, migrant workers, farmers, women, and the physically challenged, and on ensuring nationwide food security. The PMGKY included cash transfers for farmers and women, conditional cash transfers for low-income families to buy cooking gas in tanks, and free food rations for the vulnerable.In the second phase of the lockdown, 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) were allocated to programs designed to bolster agricultural infrastructure.[6] 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).[7] The swift timing of the policy enactment and the amount of money allocated to mitigate the devastating effects of the pandemic astounded most policy experts. However, before

[6] This was announced as a part of a second relief package, which was mainly focused on MSMEs and providing infrastructure support.

[7] An 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.

declaring the PMGKY a success, its role in mitigating the COVID-19 pandemic crisis in eastern India must be evaluated.

Herein lies the twofold objective of this study: first, to examine the status of food insecurity among rural households; and second, to assess the 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 Wambogo et al. 2018; Smith, Rabbitt, and Coleman-Jensen 2017; Smith, Kassa, and Winters 2017). It is an experience-based metric and relies on direct responses to eight specific questions related to food security (see below for a discussion on FIES[8]). Finally, our study uses 2020 data from 2,599 rural households from five eastern states of India: Bihar, Jharkhand, Eastern Uttar Pradesh, Odisha, and West Bengal.

[8] These question include: (1) 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? (2) 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? (3) Was there a time when you ate only a few kinds of foods because of a lack of money or other resources? (4) Was there a time when you had to skip a meal because there was not enough money or other resources to get food? (5)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? (6) Was there a time when your household ran out of food because of a lack of money or other resources? (7) Was there a time when you were hungry but did not eat because there was not enough money or other resources for food? (8) 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?

Table 1: Nutrition Indicators, selected states and India

		Children under 5 years of age			Children age 6-59 months	All women age 15-49 years
States	**Sector**	**Stunted** (%)	**Wasted** (%)	**Underweight** (%)	**Anaemic** (%)	**Anaemic** (%)
Bihar	Urban	39.8	21.3	37.5	58.8	58.7
	Rural	49.3	20.8	44.6	64.0	60.5
	Total	**48.3**	**20.8**	**43.9**	**63.5**	**60.3**
Jharkhand	Urban	33.7	26.8	39.3	63.2	59.6
	Rural	48.0	29.5	49.8	71.5	67.3
	Total	**45.3**	**29.0**	**47.8**	**69.9**	**65.2**
Odisha	Urban	27.2	17.0	26.2	38.1	47.6
	Rural	35.3	20.9	35.8	45.7	51.8
	Total	**34.1**	**20.4**	**34.4**	**44.6**	**51.0**
West Bengal	Urban	28.5	16.7	26.2	55.5	58.3
	Rural	34.0	21.6	33.6	53.7	64.4
	Total	**32.5**	**20.3**	**31.6**	**54.2**	**62.5**
Eastern UP	Urban	32.6	17.5	33.3	57.0	52.7
	Rural	36.9	16.5	39.7	60.1	52.4
	Total	**36.4**	**16.6**	**38.9**	**59.8**	**52.4**
Eastern India	Urban	32.4	19.9	32.5	54.5	55.4
	Rural	40.7	21.9	40.7	59.0	59.3
	Total	**39.3**	**21.4**	**39.3**	**58.4**	**58.3**
India	Urban	31.0	20.0	29.1	56.0	50.8
	Rural	41.2	21.5	38.3	59.5	54.3
	Total	**38.4**	**21.0**	**35.8**	**58.6**	**53.1**

Source: NFHS - 4

2. Estimating 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. These experiences are the same across developed and developing countries.[9] 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

[9] See Coates (2013), Jones et al. (2013), and Marques et al. (2015) for a history of the evolution of food insecurity.

promote its incorporation into national surveys. Smith, Rabbit, and Coleman-Jensen (2017) conclude that the experience-based metric is an effective tool for improving policies aimed at combating 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 8 questions that measure the extent of food insecurity and give it a classification ranging from moderate to severe (Table 3). The FIES has been used to assess food security issues in communities around the globe, including in the U.S. and Latin America (See Smith, Rabbit, and Coleman-Jensen 2017). For this study, we derive two outcome measures of severity of food insecurity using the same eight questions constructed by FAO-VoH.

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 that of the 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,

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

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 to 100 scale. Like many other

widely accepted scales, the FIES[10] 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.[11] Additionally, Nord (2014) noted that linear transformation retains conjoint additivity.[12]

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. As such, 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 paving the way for a standardized metric enabling international comparisons (Coates et al., 2006; Swindale and Bilinsky, 2006; Derrickson, Fisher, and Anderson 2000; Álvarez et al. 2008; Hromi-Fiedler et al. 2009; Melgar-Quiñonez 2009; Segall-Corrêa et al. 2008; Segall-Corrêa et al. 2014).

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—

[10] The 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.

[11] The results obtained through scales are comparable across countries using certain statistical techniques (i.e., Item Response Theory (IRT) models).

[12] *Conjoint* means measurement of persons and items on the same scale and *additivity* refers to the equal-interval property of the scale.

moderate and *severe*. We define "moderate"[13] and "severe"[14] 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 4,083 rural households from the same states. In the end, we were able to contact 2,599 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%). 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.[15] In a telephonic survey, we queried rural families about food security, farming operations, access to input and output markets, and the assistance provided to low-income households under the PMGKY program.

In this study, we separated rural families into two categories; namely, households[16] that received PMGKY benefits (or beneficiary households) and their counterparts (or non-beneficiary households). Table 2 provides the descriptive statistics and summary statistics of the beneficiary

[13] The threshold value or severity scale for moderate class is -0.1151.
[14] The threshold value or severity scale for severe class is 2.9826.
[15] See Kumar et al. (2020) for more details on sampling.
[16] Households are eligible for National Food Security Act (NFSA) card.

and non-beneficiary households and the overall sample. Table 2 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 non-beneficiary families belonged to the general caste of social classification, and the beneficiary families were mostly 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, non-beneficiary households had more land (about 0.32 ha) compared to beneficiary households. The share of non-farm income was about 44% for both categories of rural households. In beneficiary families, about 48% and 15% of the families had access to credit and the Kisan Credit Card (KCC), respectively. More beneficiary households (48%) had access to credit than non-beneficiary households (42%). The difference was statistically significant. Interestingly, Table 2 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 Scheme, and Table 2 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 2 show the estimated prevalence of food insecurity among beneficiary and non-beneficiary families. The Table shows that beneficiary households have a statistically significantly higher

prevalence of food insecurity (for both moderate and severe categories) than non-beneficiary families.

Table 2: Descriptive Statistics of beneficiary and non-beneficiaries of PMGKY program, India 2020

Variables	Non-Beneficiary (N=349)		PMGKY Beneficiary (N=1,762)			Overall[1] (N=2,111)	
	Mean	SD	Mean	SD	Diff	Mean	SD
Age of household head (in years)	52.79	13.42	51.06	12.18	-1.73*	51.34	12.40
Male headed household (%)	95.70	20.31	96.19	19.16	0.48	96.11	19.35
Household size (nos)	5.69	2.91	5.48	2.80	-0.21	5.52	2.82
Education (in years)	7.19	4.97	5.62	4.76	-1.56***	5.88	4.83
Education status of household head (%)							
Illiterate	22.06	41.53	31.33	46.40	9.26***	29.80	45.75
Up to Primary	28.37	45.14	34.90	47.68	6.54*	33.82	47.32
High school	24.36	42.98	14.70	35.42	-9.66***	16.30	36.94
Secondary	16.33	37.02	15.21	35.92	-1.12	15.40	36.10
Graduation and above	8.88	28.49	3.86	19.27	-5.02**	4.69	21.15
Caste (%)							
Scheduled caste	15.19	35.94	28.05	44.94	12.87***	25.92	43.83
Scheduled tribes	5.73	23.28	8.52	27.92	2.79*	8.06	27.22
Other backward caste	34.38	47.57	44.07	49.66	9.68***	42.46	49.44
General	44.70	49.79	19.36	39.53	-25.34***	23.55	42.44
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***	27.71	44.77
Marginal (<1 ha)	55.59	49.76	55.68	49.69	0.09	55.66	49.69
Small (1-2ha)	15.47	36.22	10.90	31.17	-4.58*	11.65	32.09
Medium and large (>2ha)	9.46	29.30	4.09	19.80	-5.37**	4.97	21.75
Share of income from non-farm sector (%)	44.71	30.25	44.33	27.27	-0.38	44.39	27.78
Have access to credit (%)	42.12	49.45	48.26	49.98	6.14*	47.24	49.94
Household with at least one-member migrant to other place for work (%)	24.64	43.15	28.04	44.93	3.39	27.48	44.65
Got work under MGNREGA	25.21	43.48	38.93	48.77	13.71***	36.66	48.20
Have access to Kisan Credit Card	18.34	38.75	14.70	35.42	-3.64	15.30	36.01
Opened account under JDY scheme	23.78	42.63	35.24	47.78	11.46***	33.34	47.15
Household with at least one member with above 60 years old	48.14	50.04	39.10	48.81	-9.03**	40.60	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
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

Note: [1] Sample covered 2599 households. Here we have included only those observations who had NFSA card and eligible for PMGKY scheme. We further dropped some observations due to missing responses in Food Insecurity Experience Scale (FIES) indicators.

4. The Extent of Food Insecurity in Eastern India

Table 3 shows the state-wise food insecurity status for rural households in the sampled region. Columns 2–9 reveal the percentage of rural families who reported facing food insecurity in the past month (at the time of the survey) during the lockdown period in India. About 56% of the sample reported that they were "worried" about food security. However, the percentage of households worried about food depends on if the family was a beneficiary of PMGKY subsidies. 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 3 shows mixed responses along the food insecurity scale for both beneficiary and non-beneficiary households. For instance, a greater share of non-beneficiary families skipped meals (9%), ran out of food (9%), went hungry (8%), and skipped meals for a day (5%), compared to beneficiary households. Table 3 also shows significant variation in food insecurity questions among beneficiary and non-beneficiary households and states. For instance, a more substantial share of rural households living in West Bengal and Odisha are food insecure compared to rural families living in eastern UP and Bihar. Note that Table 3 fails to address the prevalence of food insecurity among rural families in the above states. To address that problem, we calculated the prevalence of food insecurity using the Rasch Model[17].

About 18% and 0.67% of rural households in eastern India are "moderately" and "severely" food insecure, respectively (Table 4). Non-beneficiary households are less food insecure compared to beneficiary households. When comparing states, Table 4 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

[17] We calculated the Rasch score using R software's "RM.weights" and the FAO-VoH global scale.

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%).

Table 3: State-wise status comparison of indicators of food insecurity (%), India, 2020

Questions→	A	B	C	D	E	F	G	H
States	**Worried[1]**	**Healthy[2]**	**Few foods[3]**	**Skipped[4]**	**Ate less[5]**	**Ran out[6]**	**Hungry[7]**	**Whole day[8]**
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**

Notes:

[1] 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?

[2] 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?

[3] Was there a time when you ate only a few kinds of foods because of a lack of money or other resources?

[4] Was there a time when you had to skip a meal because there was not enough money or other resources to get food?

[5] 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?

[6] Was there a time when your household ran out of food because of a lack of money or other resources?

[7] Was there a time when you were hungry but did not eat because there was not enough money or other resources for food?

[8] 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?

4.1. Prevalence of Food Insecurity Across Castes

Household caste classification and land size play a critical role in any social development schemes in eastern India. Table 4 and Table 5 present the prevalence of food insecurity by social classification by caste and land size, respectively. Among social caste classes, Table 4 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 different in the case of the severe category. Table 4 shows that SCs (0.75%) are most susceptible followed by OBCs (0.74%), STs (0.52%), and general caste (0.51%). Table 4 shows that the prevalence of food insecurity differs by state and social classes of beneficiary and non-beneficiary rural families. Overall, the moderate food insecurity status of non-beneficiary households is relatively better than that of beneficiary households. However, when it comes to severe food insecurity, the beneficiary households are better off compared to non-beneficiary rural families. Thus, one can conclude that the PMGKY program was more beneficial for rural households who faced severe food insecurity. However, we will conduct a more detailed assessment of the efficacy of the PMGKY program using advanced econometric tools in the next section.

Table 4: State-wise prevalence of moderate and severe food insecurity rates across social classification—castes, India, 2020

	Moderate					Severe				
	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	16.89	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

	Moderate					Severe				
	SC	ST	OBC	General	All	SC	ST	OBC	General	All
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**

Note: SC= Scheduled Castes; ST = Scheduled Tribes; OBC=Other Backward Class; Genereal= all other castes, excluding SC, ST and OBC.

4.2. Prevalence of Food Insecurity Across Land Size Categories

Table 5 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 5 reveals that landless households from Odisha (31.14%) are most susceptible, followed by Jharkhand (20.64%), West Bengal (17.74%), eastern UP (16.77%), 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%), Eastern UP (0.74%), and Odisha (0.72%). Comparing beneficiary and non-beneficiary households in the moderate category, Table 5 shows that in the case of beneficiary households, landless farmers are more food insecure, followed by small, marginal, and medium and large farmers. But, in non-beneficiary families, small farmers (1-2 ha) are more food insecure than marginal farmers (less than 1 ha). Overall, food insecurity is relatively less prevalent among landholding households than it is among landless families, which appear to be more susceptible to both moderate and severe food insecurity.

Table 5: State-wise prevalence of moderate and severe food insecurity rate across landholding classes, India, 2020

	Moderate [1]					Severe[2]				
	L	M	S	M&L	All	L	M	S	M&L	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: L, M, S and M&L stands for Landless, Marginal, Small and Medium & Large, respectively. Marginal (<1ha); Small (1-2ha); Medium & Large (>2ha). [1] 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. [2] Severe food insecure, people may experience whole day without eating due to lack of money or other resources

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 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 and

strong instrument (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,

$$Y_{1i} = \alpha_{1i} + \beta_{1i}\text{PMGKY} + \gamma_{1i} + \varepsilon_{1i} \quad (2)$$

where Y denotes a column vector of the dependent variable (moderate and severe food insecurity scale). $PMGKY$ 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 ε is an error term with mean zero. If $PMGKY$ is exogenous to the outcome variables, then the coefficient β_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 (for example, access to information related to central and state government schemes, exposure to several programs conducted by the government, and association with local leaders, etc.) are likely to influence both treatment (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 if there are 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 is entirely dependent on the functioning of administration/governance at the village level. This instrumental variable establishes the causal relationship between PMGKY and outcome indicators. Thus, the identifying assumption is that the instrumental variable is uncorrelated with ε_2 in Equation (3).

$$Y_{2i} = \alpha_{2i} + \beta_{2i}\text{PMGKY} + \gamma_{2i} + \varepsilon_{2i} \quad (3)$$

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

$$\text{PMGKY} = \alpha_3 + \beta_3 Z + \gamma_3 X + \varepsilon, \quad (4)$$

where *Z* is the instrumental variable (IV) that reflects the efficiency of the governance structure at the village level, and ϵ is an error term with mean zero. If the instrument (Z) is valid, then the coefficient β_{2i} is the main effect (for example, local average treatment effects [LATE]) of PMGKY on the outcome variable). Further, 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. A novel component of Lewbel's (2012) technique takes care of 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. This approach is used when no external instruments are available

or used to supplement external instruments to improve the IV estimator's efficiency. 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.

6. Results and Discussions

6.1. Determinants of Participation in PMGKY

Table 6 shows the parameter estimates obtained from the probit and OLS model for factors affecting participation in the PMGKY cash transfer program. Results in Table 6 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 6, 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. Findings from this study are consistent with Magaña-Lemus et al. (2016), who found that younger households were more likely to be food insecure. As expected, the coefficient of family size (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 6, column 4).

Generally, low-income households have more family members, and these families tend to live on 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 6 show that educational attainment has a negative and significant effect on participation in the PMGKY scheme. 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 7) 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 schemes that provide services and goods of inferior quality. Additionally, our results are consistent with Magaña-Lemus et al. (2016), who found that educated HHs were less likely to be in the moderate and severe food insecurity classes and more likely to be food secure.

Social identity in the context of India is anchored by a person's social class or caste.[18] Lower castes have higher poverty rates, are less connected, have inadequate access to credit, lack information about modern technologies, and face other disadvantages. Results in Table 6 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 to 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, STs) have higher poverty rates, are less connected, have inadequate access to credit, lack information about modern technologies, and face other disadvantages. A plausible explanation could be that family members belonging to 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 as well.

[18] The 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 (OBCs).

Results in Table 6 show that compared to 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 themselves more than cash transfer program. 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 J. Lara-Álvarez (2015) and Temple (2016). Addtionally, 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 6 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 studies in migration and income diversification—members migrate to urban areas to increase income and diversify household income sources (see Reardon, Malton, and Delgado, 1988; Barrett, Reardon, and Webb, 2001; Otsuka and Yamano, 2006). 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: Factors affecting rural Indian households participation in PMGKY program (Probit and OLS models), India

	Probit Model				OLS	
Variables	**Coef**	**SE**	**dydx**	**SE**	**Coef**	**SE**
Age of household head (in years)	-0.008**	(0.003)	-0.001***	(0.001)	-0.001**	(0.001)
Household size (nos)	0.037**	(0.016)	0.007**	(0.003)	0.007**	(0.003)
Education (Base: Illiterate)						
Up to Primary	-0.173	(0.109)	-0.032	(0.020)	-0.030*	(0.018)
High school	-0.523***	(0.122)	-0.095***	(0.022)	-0.096***	(0.024)
Secondary	-0.383***	(0.127)	-0.070***	(0.023)	-0.067***	(0.024)
Graduation and above	-0.721***	(0.182)	-0.131***	(0.033)	-0.149***	(0.046)
Caste (Base: OBC)						
Scheduled Castes	0.253*	(0.133)	0.046*	(0.024)	0.030	(0.021)

	Probit Model				OLS	
Variables	**Coef**	**SE**	**dydx**	**SE**	**Coef**	**SE**
Scheduled Tribes	-0.276	(0.206)	-0.050	(0.037)	-0.041	(0.036)
General	-0.430***	(0.119)	-0.078***	(0.022)	-0.121***	(0.030)
Landholding category (Base: Landless)						
Marginal	0.003	(0.119)	0.001	(0.022)	-0.001	(0.021)
Small	-0.277*	(0.157)	-0.050*	(0.028)	-0.054*	(0.029)
Medium and Large	-0.457**	(0.193)	-0.083**	(0.035)	-0.110**	(0.046)
Share of non-farm income (%)	-0.001	(0.001)	-0.000	(0.000)	-0.000	(0.000)
Access to credit	0.105	(0.083)	0.019	(0.015)	0.018	(0.014)
Migrant member	0.173*	(0.099)	0.031*	(0.018)	0.028	(0.018)
Have KCC	-0.102	(0.125)	-0.019	(0.023)	-0.017	(0.025)
Constant	1.385***	(0.325)			1.088***	(0.040)
District fixed effect	Yes		Yes		Yes	
Observations	2,038		2,038		2,103	
R-squared					0.150	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, Clustering at village level

6.2. Impact of PMGKY on Food Insecurity

Table 7 reports the estimates of participation in PMGKY and its impact on the intensity of food insecurity (moderate and severe). The left panel of Table 7 reports estimates for moderate food insecurity, while the right panel 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 to varying degrees. When it comes to moderate food insecurity, the coefficient on PMGKY (columns 3–5, Table 7) 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 7–9, Table 7) 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 7–8, 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 programs (similar to PMGKY) that have positively impacted diet quality or improvement in economic vulnerability to food insecurity (Brugh et al., 2018; Ruiz-Arranz, 2002). Finally, our finding is consistent with Akbar, Niaz, and Amjad (2020), who found that the Benazir Income Support Progam in Pakistan reduced severe food insecurity in Pakistani households.

Table 7: Impact of PMGKY on the prevalence of moderate and severe food insecurity – Lewbel IV Method

	Moderate Food Insecurity				Severe Food Insecurity			
	OLS	Lewbel IV			OLS	Lewbel IV		
		A	B	C		A	B	C
	1	2	3	4	5	6	7	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)
Non-farm 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)
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	0.966	0.107	0.107

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Note: A, B and C stands for Standard IV, Generated IV and Both standard and generated IV, respectively.

7. Conclusions and Policy Implications

This paper expands on the existing but scarce literature on factors affecting the quality and 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 during 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 the 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), non-agricultural (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 the consumption bundle of low-income families and provides 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—as well as the food security—of all Indians. Finally, policymakers must design policies and incentives to strengthen the non-farm economy. A vibrant non-farm 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 the COVID pandemic in India. Findings suggest that government cash transfers during the crisis were instrumental in significantly reducing food insecurity in rural Indian households. 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 cash transfer programs have a direct impact on food security (diet quality or quantity) and effectively reduce economic vulnerability to food insecurity.

Acknowledgment
We thank the Indian Council of Agricultural Research (ICAR) for funding support to undertake this study under ICAR-IFPRI workplan. We are grateful to the all enumerators and other staff members who were involved in data collection, monitoring and designing the questionnaire. The views expressed here are those of the authors and do not necessarily reflect the views of the donor or the authors' institutions. The usual disclaimer applies.

References

Akbar, A., Niaz, R., Amjad, M. (2020). Determinants of households' food insecurity with severity dimensions in Pakistan: Varying estimates using partial proportional odds model. *Health and Social Care in the Community*, Vol. 28: 1698-1709.

Álvarez, M.C., Melgar-Quiñonez, H., Estrada A. & Vélez, O.L. (2008). Internal and external validation of the Latin American and Caribbean scale for the measurement of Food Safety at Home. Editorial Divergraphic. Medellin.

Barrett, C.B., Reardon, R., and Webb, P. (2001). Non-farm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food Policy*, Vol 26(4): 315-331.

Brugh, K., Angeles, G., Mvula, P., Tsoka, M., & Handa, S. (2018). Impacts of the Malawi Social Cash Transfer Program on Household Food and Nutrition Security. Food Policy, 76, 19–32.

Coates, J. (2013). Build it back better: Deconstructing food security for improved measurement and action. Global Food Security, 2(3):188–194.

Coates J, Frongillo EA, Rogers BL, Webb P, Wilde PE, Houser R. (2006). Commonalities in the experience of household food insecurity across cultures: what are measures missing? Journal of Nutrition. May;136(5):1438S-1448S. doi: 10.1093/jn/136.5.1438S.

Derrickson, J.P., Anne G. Fisher and Jennifer E. L. Anderson. (2000). The Core Food Security Module Scale Measure Is Valid and Reliable When Used with Asians and Pacific Islanders. Community and International Nutrition. Journal of Nutrition 130(11):2666-74. DOI: 10.1093/jn/130.11.2666

Grebmer, K. von, J. Bernstein, R. Mukerji, F. Patterson, M. Wiemers, R. Ní Chéilleachair, C. Foley, S. Gitter, K. Ekstrom, and H. Fritschel. (2019). 2019 Global Hunger Index: The Challenge of Hunger and Climate Change. Bonn: Welthungerhilfe; and Dublin: Concern Worldwide.

Gulati, A., Ganesh-Kumar, A., Shreedhar, G., Nandakumar, T., 2012. Agriculture and malnutrition in India. Food Nutr. Bull. 33 (1), 74–86.

Gundersen CG, Garasky SB (2012) Financial Management Skills Are Associated with Food Insecurity in a Sample of Households with Children in the United States. *Journal of Nutrition*, Vol 142(10):1865–1870.

Hromi-Fiedler A., Bermúdez-Millán A., Melgar-Quiñonez H. & Pérez-Escamilla R. (2009) Psychometric properties of an adapted version of the US Household Food Security Survey Module for assessing food insecurity among low-income pregnant women. Journal of Hunger and Environmental Nutrition 4, 81– 94

Ito, T. (2009). Caste discrimination and transaction costs in the labor market: Evidence from rural North India. Journal of Development Economics, Vol. 88 (2): 292-300.

Jones, A. D., Ngure, F. M., Pelto, G., & Young, S. L. (2013). What are we assessing when we measure food security? A compendium and review of current metrics. *Advances in Nutrition: An International Review Journal*, 4(5), 481–505.

Kumar, A., Ashok K. Mishra, Vinay K. Sonkar, and Sunil Saroj. (2020). Access to Credit and Economic Well-Being of Rural Households: Evidence from Eastern India. Journal of Agricultural and Resource Economics 45(1):145–160.

Lewbel, Arthur. (2012) Using Heteroscedasticity to Identify and Estimate Mismeasured and Endogenous Regressor Models, Journal of Business & Economic Statistics, 30:1, 67-80, DOI: 10.1080/07350015.2012.643126

Magaña-Lemus D, Lara-Álvarez J (2015) "Food Security Measurement: An Empirical Approach", in Andrew Schmitz, P. Lynn Kennedy, Troy G. Schmitz (ed.) Food Security in an Uncertain World (Frontiers of Economics and Globalization, Volume 15) Bingley, UK: Emerald Group Publishing Limited; pp. 49–62.

Magaña-Lemus, D. Ishdorji, A., Rosson, C. P., Lara-Alvarez, J. (2106). Determinants of household food insecurity in Mexico. Agricultural and Food Economics, Vol. 4(10). https://doi.org/10.1186/s40100-016-0054-9.

Marques, E. S., Reichenheim,M. E., de Moraes, C. L., Antunes, M. M., & Salles-Costa, R. (2015). Household food insecurity: A systematic review of the measuring instruments used in epidemiological studies. *Public Health Nutrition*, 18(5), 877–892.

Melgar-Quiñonez, (2009). Towards an International Household Food Security Measurement. Journal of Nutrition Education and Behavior 41(4). S11.

Nord, M. (2014). Introduction to Item Response Theory applied to Food Security Measurement: Basic Concepts, Parameters, and Statistics. Technical Paper, FAO, Rome, 2014 (available at<http://www.fao.org/economic/ess/ess-fs/ voices/en >).

Otsuka, K. and Yamano, T. (2006). Introduction to the special issue on the role of non-farm income in poverty reduction: evidence from Asia and East Africa. *Agricultural Economics,* Vol. 35(s3), pages 393-397.

PLFS (2018). Period Labour Force Survey, National Sample Survey Office, Ministry of Statistics and Programme Implementation, National Statistics Office. Government of India.

Raghunathan K, Chakrabarti S, Avula R, Kim SS (2017) Can conditional cash transfers improve the uptake of nutrition interventions and household food security? Evidence from Odisha's *Mamata* scheme. PLoS ONE 12(12): e0188952. https://doi.org/10.1371/journal.pone.0188952

Reardon, T., Malton, P. and Delgado, C. (1988). Coping with Household-level Food Insecurity in Drought-affected Areas of Burkina Faso. *World Development* 16(9): 1065-1074.

Ruiz-Arranz, M., Davis, B., Stampini, M., Winters, P., & Handa, S. (2002). More Calories or More Diversity? An econometric evaluation of the impact of the PROGRESA and PROCAMPO

transfer programmes on food security in rural Mexico. 47 pages. https://doi-org.ifpri.idm.oclc.org/ftp://ftp.fao.org/docrep/fao/007/ae028e/ae028e00.pdf

Segall-Corrêa AM, Marin-León L, Sampaio MDFA, Perez-Escamilla R, Pacheco L, Souza RP. (2008). Transfer of income and food security to Brazil; analysis of national data [cash transfer and food insecurity in Brazil]. Revista de Nutrição (Brazilian J Nutr) 2008; 21 (supplement): 39–52.

Segall-Corrêa , A. M., Leticia Marin-Leon, Hugo Melgar-Quiñonez, Rafael Pérez-Escamilla. (2014). Refinement of the Brazilian Household Food Insecurity Measurement Scale: Recommendation for a 14-item EBIA. Revista de Nutrição 27(2):241-251.

Smith, M.D., Kassa, W., and Winters, P. (2017). Assessing food insecurity in Latin America and the Caribbean using FAO's Food Insecurity Experience Scale. Food Policy, 71:48-61,

Smith, M.D., Rabbitt, M. P., Coleman-Jensen, A. (2017). Who are the World's Food Insecure? New Evidence from the Food and Agriculture Organization's Food Insecurity Experience Scale, World Development, Volume 93:402-412.

Swindale, A. and Bilinsky, P. (2006). Development of a Universally Applicable Household Food Insecurity Measurement Tool: Process, Current Status, and Outstanding Issues. Journal of Nutrition 136(5):1449S-1452S. DOI: 10.1093/jn/136.5.1449S.

Temple, J.B. (2016). Severe and Moderate Forms of Food Insecurity in Australia: Are They Distinguishable? Australian Journal of Scocial Issue, Vol. 43(4): 649-668.

Trading Economics (2020). GDP Annual Growth Rate - Forecast 2020-2022. https://tradingeconomics.com/india/gdp-growth-annual. Access on September 07th 2020.

Wambogo, E.A. Ghattas, H., Leonard, K L., Sahyoun, N. R. (2018). Validity of the Food Insecurity Experience Scale for Use in Sub-Saharan Africa and Characteristics of Food-Insecure Individuals, Current Developments in Nutrition, Volume 2, Issue 9: 1-10.

WFP (2020). COVID-19 will double number of people facing food crises unless swift action is taken. https://www.wfp.org/news/covid-19-will-double-number-people-facing-food-crises-unless-swift-action-taken. Accessed on September 07th 2020.

World Bank. (2020). Purchasing Power Parities and the Size of World Economies: Results from the 2017 International Comparison Program. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/33623

Appendix

Table A1: Lewbel IV test

Lewbel IV Test	Standard IV	Generated IV	Both standard & generated IV
Weak identification test (Cragg-Donald Wald F statistic):	120.73	130.98	125.44
(Kleibergen-Paap rk Wald F statistic):	215.83	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	17.25	32.77	33.99
Hansen J statistic (overidentification test of all instruments):	20.08	37.58	41.55
Chi-sq(46) p-value=	0.77	0.74	0.66
-orthog- option:			
Hansen J statistic (eqn. excluding suspect orthog. conditions):			37.55
Chi-sq(44) p-value =			0.74
C statistic (exogeneity/orthogonality of suspect instruments):			4.00
Chi-sq(2) p-value =			0.14