Food Price Subsidies & Nutrition in India: Is Less Targeting more?

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Abstract: India's Public Distribution System (PDS) is the largest food-based social safety net in the world, and many in India argue that it should be universalized rather than targeted based on household income. We use a natural experiment to ask whether universalizing PDS in the Indian state of Odisha improved access to PDS entitlements and ultimately women's health. In 2008, the Odisha government simultaneously increased PDS entitlements and universalized access to the PDS in the particularly poor Kalahandi-Balangir-Koraput (KBK) region. In the rest of the state, the government increased PDS entitlements for poor households in an equivalent manner, but did not universalize PDS. We exploit this variation in reform implementation and and find that while universalization had little effect on women's health (BMI) in above poverty line households, it improved health in below poverty line households. We also examine the mechanisms that drive these improvements in health.

JEL Codes: O12, I15, I14

Benefits meant exclusively for the poor often end up being poor benefits.
- Amartya Sen (1992)

1. Introduction

India's Public Distribution System (PDS) is perhaps the largest food safety net program in the world, accounting for over 1 percent of India's GDP, and growing in size (Kumar et al. 2017). For families below the poverty line, the implicit subsidies from PDS can be large – in many states equivalent to a week of NREGA wages every month (Khera 2011). Families above the poverty line were historically excluded from this targeted program, but increasingly, Indian states are widening the criteria for PDS inclusion. Average PDS purchases of wheat and rice doubled between 2004/5 and 2009/10 (Dreze and Khera), for instance, partly with improved efficiency but also with expanded entitlements. In 2013, India's congress passed the National Food Security Act, moving the PDS and other food safety nets from an entitlements-based approach to a right-based approach. This Act expanded PDS coverage further especially in rural areas, but stopped short of the universalization that many called for. During the Covid-19 pandemic, it became evident that ~100 million Indians who should have qualified for entitlements were still excluded from the PDS by their inability to procure ration cards (Khera and Somanchi, 2020); this fact drew national outcry after a 5-year-old girl in such a family starved to death during a Covid lock-down.[1][2]

So, the question of who should be included and excluded from India's PDS program is topical, and likely important for policy outcomes. In this paper, we ask whether universalizing the PDS in the Indian State of Odisha improved access to PDS entitlements and ultimately women's health. To do so, we use a natural experiment. In 2008, the Odisha government simultaneously increased PDS entitlements and universalized access to the PDS (i.e., provided equal entitelments to households above and below the poverty line) in the particularly poor Kalahandi-Balangir-Koraput (KBK) region. In the rest of the state, the government increased PDS entitlements for poor households in an equivalent manner, but did *not* universalize PDS. We find that while universalization had little effect on women's health (BMI) in above poverty line households, it improved health in below poverty line households. We also see that the women who were underweight in our baseline data were particularly, positively impacted by universalization. These (early) results suggest that universalization in the KBK region of Odisha improved access to entitlements and therefore human welfare in the poorest families, as in fact policymakers intended it to do.

Our paper is the second that we know of to examine the causal impact of PDS universalization on nutrition outcomes, which is suprising given that PDS universalization is increasingly discussed and implemented in states across India. It is also the first paper that we know of to examine the impact of the PDS on a direct measure of health. There is substantial literature discussing how universalization affects PDS functioning but few have looked at the direct impact it has on women and child's health and nutrition outcomes. Rahman (2016) exploits the same natural experiment that we use in Odisha to examine the impact of universalization on food and nutrient consumption. He finds that indeed, universalization increases calorie, protein, and fat intake from a variety of

[1] This inability stemmed partly from the government fixing ration card supply according to outdated population estimates. Particular sub-populations like migrant laborers facing separate constraints to accessing entitlements.
[2] https://www.aljazeera.com/news/2021/9/6/india-poor-ration-card-food-grains-pds-poverty
https://thewire.in/rights/covid-19-100-million-hunger-pds-universal

cereal and non-cereal sources. However, his paper cannot speak to *which* households were impacted by the reform, and he does not examine health directly.[3] Studies on the effectiveness of the PDS more broadly – not the impact of universalization in particular – have often suggested that it was fairly ineffective in the 1990s and early 2000s (Kochar 2005), but that access to PDS entitlements and hence the program's impact on food intake has improved over time (Krishnamurthy et al. 2014a, Kishore and Chakrabarti 2015, Kumar et al. 2017; Khera 2011).

Our findings contribute to literature on the targeting of social safety nets. In poor countries, social safety net beneficiaries are often selected through a "proxy means test" (PMT): the government collects information on household assets and demographic characteristics (the "means" through which households achieve income and consumption), creates an index based on that information (in theory "proxying" for the permanent component of income), and determines program eligibility based on an index cut-off. Precisely such a method was used for the PDS ration card status, and hence entitlement eligibility, in India. During the 2004-2012 period that we study, PDS ration card status was based on household data gathered in India's 2002 census.[4] The method defined 13 criteria (reflecting asset ownership, education, occupation, etc.), each with a score from 0-4, resulting in an aggregate index that varied from 0-52. Localities each defined an index cut-off for determining poverty status (Sundaram 2003). Unfortunately, the resulting ration card status was not well aligned with either per capita expenditure or wealth index in nationally representative data from 2004 (Dreze and Khera 2010).

This may not be surprising; determination of poverty by a PMT is obviously imperfect. It suffers from faults in the original survey, measurement error in the collected data, and from the inconvenient fact that poverty status varies over time. A long list of authors have suggested that community-based targeting might leverage local information to out-perform PMT targeting, though two recent experiments find that it yields little improvement when it comes to predicting consumption (Atlas et al. 2012, Karlan & Thuysbaert 2019). Henderson and Follett (2022) alternatively propose that targeting on observable welfare "ends" (e.g. food security, health) is superior to targeting on the "means" of creating welfare (assets, education), and further that ideally one should target on the capacity to achieve those ends rather than the ends themselves.[5] Yet such capability targeting has never been tested experimentally, and is likely to prove challenging. Hausfer et al. (2022) point out that targeting on any measure of welfare may be inefficient if the poorest households have lower than average treatment effects – targeting on a combination of poverty and predicted treatment effect would then be optimal. Yet predicting treatment effect is also likely to prove challenging. Also, if the goal is to reduce poverty, policymakers should logically alter the program itself rather than the targeting of it, if they realize that treatment effects are low for the poorest households.

[3] Rahman (2016) does attempt a triple difference estimation that would separate impact for above poverty line and below poverty line households. However, it is implemented incorrectly (without all necessary interactions) and does not account for the pre existing differences in PDS subsidy that existed across different spatial regions of Odisha before the 2008 reform.

[4] In fact, because some households during 2004/2005 had not yet received 2002 census ration cards, they were using ration cards based on the 1997 census (Khere and Dreze 2010). Khera (2008) argues that this first proxy means test was even more faulty than the subsequent one, with faulty criteria and a uniform cut-off across India.

[5] Here they are following closely on Sen (1992). The importance of capacity is easily illustrated by comparing a family that is starving to a family that is fasting.

So while the search continues for improved forms of targeting, we compare the effects of traditional PMT targeting – in a context where it is known to be highly imperfect – to the effect of no tagetting at all. We hypothesize that universalizing the PDS in Odisha might reduce exclusion errors (by providing entitlements to poor families who are not deemed poor by their ration card status), and could additionally improve the quality of benefits for all families, since "benefits meant exclusively for the poor often ends up being poor benefits" (Sen 1992). At this early stage in our analysis, we find evidence that both mechanisms are likely to be at play.

2. Background: PDS in Odisha and the 2008 reforms

In 2006, by the order of the Indian Supreme court, a committee headed by retired Justice Wadhwa was formed to identify the problems afflicting the Public Distribution System (PDS) of various states, and to suggest remedial measures. In its report for Odisha, the committee criticized the state's PDS for its lack of transparency, corruption, poor targeting, and maladministration (Wadhwa, 2009). The subsequent recommendations made by the committee resulted in the Odisha government undertaking a series of reforms to strengthen its PDS. These included abolition of private storage agents,[6] handover of previously privately-owned PDS outlets (stores where one goes to buy PDS items) to community institutions, separation of grain transport and grain distribution agencies, GPS tracking of PDS items, doorstep delivery of PDS items to PDS outlets, and use of new inclusion and exclusion criteria for identification of PDS beneficiaries under the national Food Security Act (The Odisha Gazette, 2016; Kumar et al, 2017; Government of Odisha, 2020).

While many of these above-mentioned initiatives were taken close to or after 2011, the state government had already kickstarted the reform process around 2004 with decentralization of rice procurement and deployment of mobile vans to reach remote regions (Kohli et al, 2017). We can therefore think of the Odisha PDS reform process as beginning in 2004 and ramping up over time. One of the major components of the Odisha reform process was a change in rice subsidies in 2008 – a change in subsidy level, and in some places also a change in subsidy targeting. This targeting change can be seen in the context of a long policy debate in India about effective targeting for the poor. When the PDS was started by the Indian government during the Second World War, all families were eligible for subsidized grain: war rations.[7] Launched more formally in 1947 after the war's end, all families remained elegible for subsidied grain under system meant to decrease food insecurity rates and stimulate agricultural production. In 1997 the PDS was restructured so as to provide grain subsidies only for families who fell "below poverty line," in theory increasing efficiency. Families "above poverty line" were generally not eligible for grain subsidies. In 2000, a final category guaranteed the greatest subsidies for the poorest of the poor.[8]

[6] Prior to reforms, Odisha had a 62 year old private storage system in place which as pointed in the Wadhwa committee report was one the main source of grain diversion. These private storage agents responsible for storing state allocated PDS would collude with Millers (whom government gave rice for extraction) to divert PDS ration for personal profits. Following Wadhwa committee suggestions, in 2011 the state piloted a more centralized system in 4 districts, and in 2012 private storage agents wre abolished state-wide, replaced by a new storage system managed by the state-run Orissa State Civil Supplies Corporation.

[7] Rationing in India dates back even further, to the Bengal Faminine in 1940

[8] These families were categorized as being part of the Antyodaya Anna Yojana ("grain scheme for the downtrodden"). In our analysis we combined Antyodaya Anna Yojana families with "below poverty line" families, because in all time periods their subsidies were the same in Odisha.

Figure 1: Odisha District Groupings Relevant to the 2008 Price Reform Policies

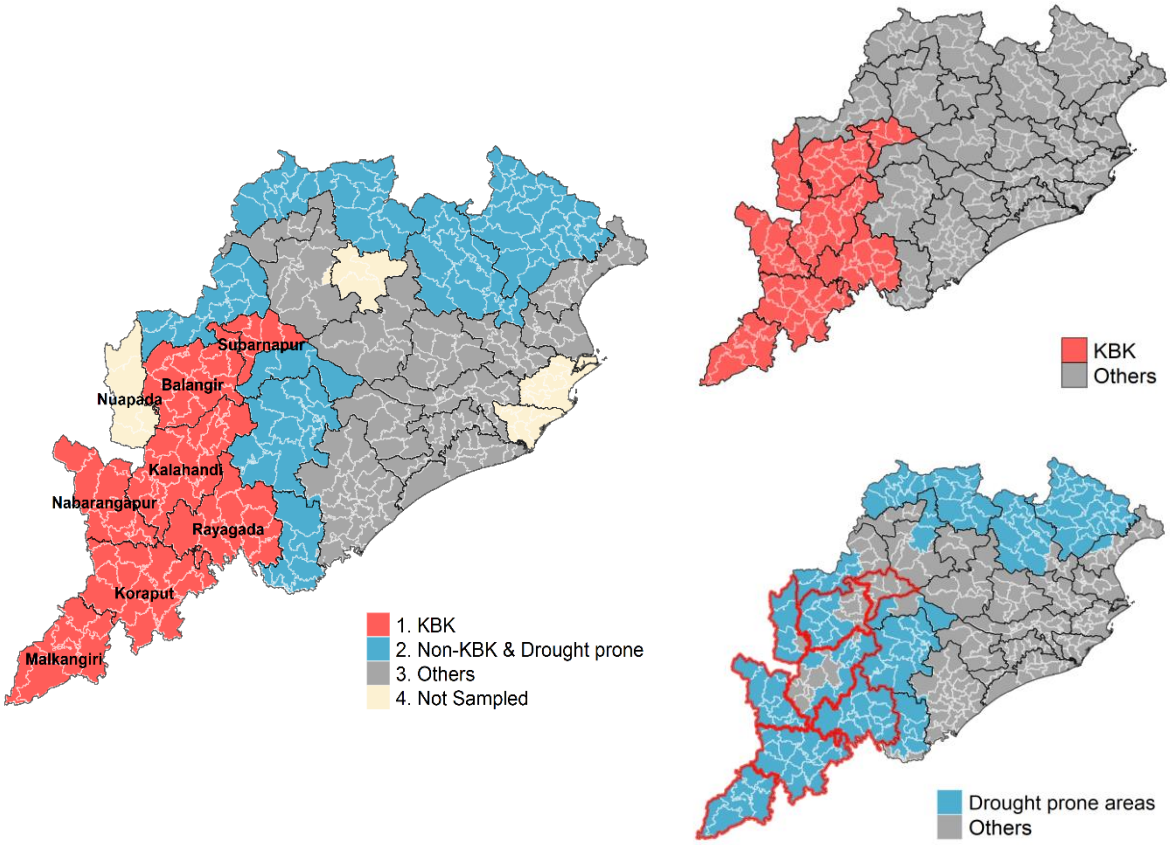


Figure 1 illustrates the location of the three key geographic areas: KBK districts, non-KBK districts holding drought-prone blocks, and non-KBK districts without drought-prone blocks. Prior to the 2008 price reform, only those families in Odisha that held a below poverty line ration card were entitled to receive 25 kgs of subsidized rice – as in the majority of India. An exception was made, however, for families residing in the particularly poor Kalahandi-Balangir-Koraput (KBK) districts. In KBK districts, where even relatively well-off families were generally quite poor, families designated as "above poverty line" were also entitled to subsidized rice, and paid only a slightly higher price per kg than families who were "below poverty line": 6.3 Rs/kg, as opposed to an effective 5.3 Rs/kg.[9]

Additionally, while below povery line households prior to 2008 were entitled to subidized rice in all districts of Odisha, the price they paid varied slightly by region. Approximately half of Odisha's districts hold blocks designated as Integrated Tribal Development Project (ITDP) and/or Drought

[9] The Kalahandi-Balangir-Koraput region (KBK) is comprised of 8 districts (80 blocks) in south-west Odisha. This resource rich, tribal dominated region was identified in the 1990s as one of the poorest regions of the country. As a result, both center and state governments have adopted a special area development approach and implemented various kinds of schemes in these districts to accelerate its development (Planning commission, 2002).

Prone Area Program (DPAP) blocks,[10,11] which we will henceforth refer to collectively as "drought-prone" blocks. These drought-prone blocks are particularly poor, like the KBK districts (In fact, many are in KBK districts.) Thus, while below poverty line families in non-KBK, non-drought-prone districts were entitled to a buy 25 kg of rice at 6.3 Rs/kg, poor families in KBK districts and/or in these drought-prone blocks were entitled to buy 16 kgs of rice at 4.75 Rs/kg and to buy their remaining 9 kgs of rice at 6.30 Rs/kg, for an effective, average 5.3 Rs/kg for families availing themselves of their full entitlement of 25 kg per month. **Table A1** holds this information in the rows marked 2004-2005, which is the time period for our first round of data.

The 2008 reform was made of up two components (**Table A1**). First, across Odisha, the price of PDS rice was dropped to 2 Rs/kg for families below poverty line. In both KBK districts and non-KBK, drought-prone blocks, this amounted to two changes, vis-à-vis the pre-reform scenario: (i) a reduction in price (from an effective 5.3 Rs/kg to 2 Rs/kg) and (ii) a simplification of the pricing system (a single price for all 25 kg rather than one price for the first 16 kg, another for the second 9 kg). This simplification was motivated by the observation that a 2-price system was difficult to manage from both the demand and supply side, and that many below poverty line familes were not obtaining their full entitlement because of it. In the rest of Odisha, only a reduction in price was experienced, with no simplification. This reduction was very slightly larger than the reduction in the KBK districts and non-KBK drought-prone blocks (a 68 vs. 62 percent reduction).

Second, in the KBK districts only, "universalization" was implementd. That is, above poverty line families who had previously experienced very little subsidy for rice (a PDS price of 6.3 Rs/kg, when the market price was 8.5 Rs/kg) were now entitled to the same price as were below poverty line families: 2 Rs/kg. Policy-makers were motivated to bring above poverty line families in KBK into the PDS fold for three reasons. First, it was thought that even above poverty line families in KBK were fairly poor (the same logic that had led them to recieve a small subsidy even before the reform). Relatedly, since the asset means test that dictates one's ration card status is imperfect, it is always possible that families who should truly be designated as below poverty line are erroneously designated as above poverty line. Last, some believed that above poverty line families might be better equipped to demand accountability from the PDS system in KBK.

A priori the nutritional impact of rice subsidy expansion (whether through improved functioning of the PDS system or simply greater subsidies) is ambiguous. These subsidies effectively increase income, and that increased income may be spent on non-food goods, or on nutritious foods like lentils, animal-sourced foods, fruit or vegetables, or on non-nutritious snack foods. If indeed families increase calorie intake or dietary diversity as a result of subsidy expansion, this should be observable in consumption data. An improvement in ultimate nutritional status should also be observed if indeed limited calories, dietary diversity, protein, or nutrients were a primary constraint on nutritional status. And if nutritional status is easier to measure than dietary quality (possibly the

[10] The 118 Integrated Tribal Development Project (ITDP) blocks have a scheduled tribe population of more than 50%, and thus receive special central assistance under the tribal sub plan for the welfare of the tribal communities (Bhuria, 2004; Ministry of Tribal Affairs, 2016). Additionally, 47 blocks from eight districts are included under the Drought Prone Area Program (DPAP), which was launched countrywide by the central government in 1973-74 to tackle special problems faced by drought affected regions across India (Ministry of Rural Development, 1994).
[11] The administrative structure of India comprises of 28 states. Each state is subdivided into districts. Odisha consists of 30 districts which have been further subdivided into 314 blocks.

case in household-level data particularly), it is possible that one might observe a nutritional impact even when a dietary impact is not observed.

Table 1: Effective subsidy, before and after the 2008 price reform (in Rs/25 kgs)

	Above poverty line			Below poverty line		
	KBK	Non-KBK & drought-prone	Other	KBK	Non-KBK & drought-prone	Other
2004-05	49.75	0.00	0.00	70.55*	79.80*	53.75
2011-12	211.10	0.00	0.00	198.58	218.79	206.83
Price Change (Rs)	161.35	-	-	128.03	138.99	153.08
Price Change (%)	324%			181%	174%	285%
Policy Change	Universal	-	-	Universal & Simple	Simple	-

Notes: Effective subsidy has been reported at 2004-05 constant prices. It is calculated by multiplying the difference between the subsidized price and the average market price for rice reported by IHDS respondents with the total 25 kgs entitlement to which a beneficiary is eligible under PDS. "KBK" indicates all KBK districts, some of which also hold drought-prone blocks. "Non-KBK and drought-prone" indicates all drought-prone blocks within non-KBK districts. "Other" indicates all blocks within non-KBK districts that were not designated as drought-prone. *In round 1, below poverty line households in KBK districs and non-KBK drought-prone blocks were given their first 16 kgs at Rs 4.75 per kg and their remaining 9 kgs at Rs 6.30 per kg (Government of Orissa, 2005). This dual price has been considered when calulating the effective subsidy.

Even if we take for granted that increased rice subsidies should positively impact nutritional status, it is worth stating clearly what impacts might be expected where, from each component of this 2-part reform. First, if the *reduction in entitlement price* improved welfare, we would expect to see that improvement for all below povery line families in Odisha, and also for above poverty line families in the KBK districts only. As summarized in **Table 1**, the effective subsidy for below poverty line families increased by at least 2.5 times across all the three spatial groups. This increase was driven by reduction in the price of PDS rice on one hand and a sharp increase in the market price of rice on the other. However, the increase in effective subsidy for below poverty line families in the non-KBK, non-drought-prone (or "other") regions of Odisha was only slightly greater than the KBK districts, making it likely that we would not see much differences in impact across regions. Moreover, if we believe that the initial 2-tier price system for below poverty line families in KBK districts and drought-prone blocks was hampering these families from receiving their full entitlement, they may have been paying something closer to 6.2 Rs/kg to begin with, making the joint impact of price reduction and price simplification even more similar across the various regions of Odisha. In contrast, we would expect the welfare gains from reduction in price entitlement to be limited to the above poverty line families in KBK districts, for whom the effective subsidy increased nearly 4.25 times relative to other regions where no subsidy expansion happened.

Second, if the *elimination of targeting* in KBK indeed improved the overall functioning of the PDS system, we should see a greater improvement for below poverty line families in KBK than we see for below poverty line families in the rest of Odisha. Moreover the substantial subsidy expansion

for above poverty families in KBK region would also have incentivised such families to come into the PDS fold and substitute market rice with the much cheaper PDS rice.[12] Advocates of universalization suggest that inclusion of relatively better off sections of society can also contribute to greater accountability. If doing away with targeting and increased participation by above poverty line households in KBK improved the state's ability to reach the most vulnerable families (i.e., those that were previously designated as above poverty line, or who had not bothered to get cards at all because they knew they would be designated as above poverty line), then we should also see a greater improvement for the poorest and most malnourished families, regardless of card status, in KBK than in the rest of Odisha.

3. Data and Descriptive Statistics

We use two rounds of Indian Human Development Surveys (IHDS-1 and IHDS-2) conducted in 2004-05 and 2011-12 respectively. This nationally representative panel survey was conducted in India through the joint efforts of University of Maryland and the National Council of Applied Economic Research (NCAER) (Desai et al., 2007; Desai et al., 2015). Our sample includes adult women (aged 20 years and above at the time of survey) from approximately 1000 households having different ration card holding status.[13]

In this study we use women's Body Mass Index (BMI) as the nutrition outcome variable calculated using anthropometric data on women's height and weight. Since we are interested in looking at the impact of reform across the three key geographic areas: KBK, Non-KBK drought prone areas and the other remaining regions, we also construct relevant region dummies using the district level information in the data. Ideally the region dummy should be constructed at the block level. Unlike KBK status which is assigned at district level, the drought prone area status is assigned at the block level.[14] But IHDS data only provides geographical information up to the district level and does not identify the block due to confidentiality reasons. This forces us to construct our region dummies at the district level. This is a problem because while some districts (like Sundargarh and Rayagada) are made up *only* of drought-prone blocks, there are also districts (like Gajapati and Kalahandi) where only *some* blocks are designated drought prone.

Details on district-wise block coverage under ITDP-DPAP program are provided in **Table A2**. We look at the coverage levels under ITDP-DPAP program to determine which districts should be classified as drought prone. All districts where 50% or more blocks are drought prone are classified as drought prone districts and vice versa. We then use this KBK and drought prone classification to construct our three region dummies. KBK includes all 8 districts that have KBK status, non-KBK drought prone districts includes 7 districts that are not KBK but have 50% or more blocks under ITDP-DPAP program. All the remaining 15 districts are classified in the Other category.

[12] Justice Wadhwa committee report (2009) mentions that the number of beneficiaries increased from 30 to 55 lakh following the 2008 subsidy expansion.

[13] India has one the highest prevalence of undernutrition among women. Jose (2011) use NFHS-3 2005-06 data to show that 35.6% of adult women (15-49 years) suffer from chronic energy deficiency (BMI < 18.5) with adult men only marginally behind. This poor nutrition outcome is also reflected in the data for Odisha, where the incidence among both women and men is above the national average at 41.6% and 35.7% respectively. Although the high incidence among both the sexes is concerning, lack of data on men's anthropometric outcomes prevents us from conducting this empirical exercise for men.

[14] The administrative structure of India comprises of 28 states. Each state is subdivided into districts. Odisha consists of 30 districts which have been further subdivided into 314 blocks.

Table 2: Summary Statistics

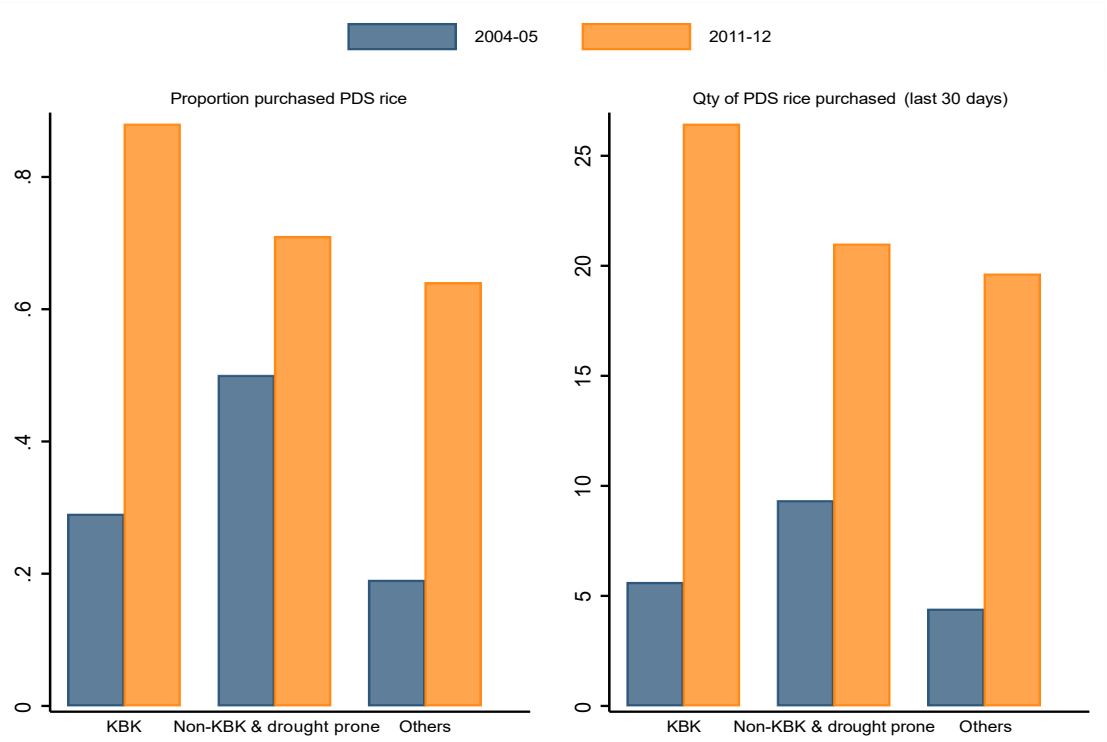
	KBK	Non-KBK & drought prone	Others
IHDS-1 (2004-05)			
BMI (kg/m²)	19.24	20.14	20.01
Age (years)	33.27	33.88	34.42
Education (years)	1.68	2.68	3.54
Age at first union/gauna (years)[15]	17.04	17.77	18.26
Number of kids ever born (#)	2.97	3.32	3.08
Currently pregnant (binary)	0.02	0.03	0.04
Household head is Scheduled Tribe (binary)	0.21	0.41	0.05
Household head is Scheduled Caste (binary)	0.23	0.18	0.26
Household head is Hindu (binary)	0.97	0.81	0.98
Rural residence (binary)	0.95	0.90	0.88
Improved source of drinking water (binary)	0.93	0.72	0.65
Improved toilet (binary)	0.02	.06	.08
N	170	284	551
IHDS-2 (2011-12)			
BMI (kg/m²)	21.46	20.5	21.29
Age (years)	41.71	41.05	41.1
Education (years)	1.98	2.78	4.09
Age at first union gauna (years)	17.13	17.43	18.32
Number of kids ever born (#)	3.48	3.72	3.41
Currently pregnant (binary)	0.03	0.01	0.00
Household head is Scheduled Tribe (binary)	0.21	0.42	0.05
Household head is Scheduled Caste (binary)	0.23	0.21	0.27
Household head is Hindu (binary)	0.94	0.89	0.98
Rural residence (binary)	0.94	0.84	0.81
Improved source of drinking water (binary)	0.95	0.82	0.75
Improved toilet (binary)	0.04	0.08	0.22
N	170	284	551

We display summary statistics by region and across the two rounds in **Table 2.** Average BMI of adult women in Odisha in both the rounds lies within but towards the bottom of a "normal" weight range (18.5-24.9 kg/m^2) according to WHO 2006 guidelines. Women residing in KBK districts, not surprisingly, had a lower average BMI (19.24 kg/m^2) than those residing in other districts in round 1, but saw the largest improvement in average BMI by round two. On average, women in our sample were around 33 years old, had less than 4 years of schooling, had three kids, and had their first gauna at 17-18 years of age in 2004-05 survey round. Except for education and BMI,

[15] Gauna is a custom largely observed in northern parts of India and is mainly associated with child marriages. While marriage rituals might be performed at a young age, the bride continues to live with her natal family till the Gauna ceremony is performed. It is only once Gauna is completed that the bride goes to live with her husband and conjugal relations begin.

which were both lower in the KBK districts, women in our sample share similar individual characteristics across the three regions and across the two rounds. As far as household characteristics are concerned, the majority of the sampled women belong to a Hindu headed household and reside in rural area. While the proportion of women designated as scheduled caste is similar across regions, a significantly higher proportion of scheduled tribe women (~40%) live in non-KBK drought prone districts. Another interesting thing to note is that access to improved toilet and drinking water varies substantially across the three spatial groups and shows big jumps in some cases over the two rounds.

Figure 2: Changes in PDS rice purchases, by survey round and region



Note: IHDS survey asked respondent to report if the quantity of rice (in kgs) purchased from a PDS shop in the last 30 days. This variable was used to create both the binary and the contintuous quantity variable.

Figure 3 shows substantial increases in purchase of rice from PDS between 2004-05 and 2011-12. Both the proportion who reported purchasing PDS rice and the kgs of rice purchased from PDS in the last 30 days showed big jumps across all the three regions. But the highest increase was seen in the KBK region, where the proportion of people who reported purchasing PDS rice increased from 29% in 2004-05 to 88% in 2011-12 and the quantity consumed increased by 20.83 kgs. This suggests and gives confidence that the reform was properly implemented. Moreover, the improvement is observed across all the three spatial groups which again gives confidence that either the reform or any other PDS change that led to effective implementation was done equally well across all the districts although district fixed effects would allow us to control for any non-reform related district wide time-invariant variation.

4. Empirical Strategy

Since we do not have yearly measures of women's BMI leading up to the policy change in 2008, we cannot test for pre-trends in women's BMI. Instead, we examine pre-trends in the height of women born between 1949 and 1989 using IHDS-2.[16] Adult height is crucially linked with nutrition in early childhood and is often used as a measure of cumulative net nutrition (Perkins et al., 2016). We can safely assume that most women attain their adult height by the time they reach the age of 20, and so we restrict our sample to women who were at least 20 years of age at the time of policy change, i.e, born prior to 1989.[17]

$$Height_{ijt} = \alpha + \beta_1 Age_i + \beta_2 KBK_j * Age_i + \beta_3 DP_j * Age_i + \beta_4 KBK_j + \beta_5 DP_j + \epsilon_{ijt} \qquad (1)$$

Since we conduct analysis separately for above and below poverty line women, we also estimate eqation (1) separately for these two subgroups, to test for pre-trends. In the above equation our outcome variable ($Height_{ijt}$) is the height at time *t* of i^{th} women residing in j^{th} district. Our explanatory variables includes women's age (Age_i), a dummy for being in the KBK region (KBK_j), a dummy for being in the non-KBK drought prone region (DP_j), an interaction between women's age and KBK region dummy, and an interaction between women's age and non-KBK drought prone region dummy. As part of robustness check, we repeat this exercise using NFHS-4 data, collected in 2014-15, that allows us to work with a much larger sample.

As explained in **Section 2,** due to pre-existing differences in price entitlements of different card holders across different geographic regions before 2008, we expect the impact of the reform to vary both spatially and across different ration card groups. We estimate equation (2) separately for above and below poverty card holders and only consider women's baseline ration card holding status. For above poverty line ration card holders we only include those women in our panel who reported holding above poverty line ration card in 2004-05 survey round. Similarly, we also do this when estimating the reform impact for below-poverty line women. This is done to control for self-selection bias since slightly well-off households in KBK districts could have bribed their way to above poverty line status post policy change to take advantage of the subsidy benefits.

$$BMI_{ijmt} = \alpha + \beta_1 KBK_j * post_t + \beta_2 DP_j * post_t + X_{ijt} + \Upsilon_{mt} + \theta_j + \epsilon_{ijt} \qquad (2)$$

In the above equation our outcome variable (BMI_{ijmt}) is body mass index in month *m* of year *t* of i^{th} women residing in j^{th} district. Our explanatory variables includes the interaction between a dummy for being in the second, post-policy time period ($post_t$) and a dummy for being in the KBK region (KBK_j), an interaction between $post_t$ and a dummy for being in the non-KBK drought prone region (DP_j). We also include individual and household characteristics (X_{ijt}), month-year fixed effects (Υ_{mt}), and district fixed effects (θ_j) in our equation to control for other factors that are correlated with women's BMI. The district and month year fixed effects renders the two region

[16] Future draft would also check pre-trends in birthweight for infants born before 2008 using AHS 2010-101

[17] Examining pre-trends in "cumulative health" of women born prior to 1989 provides us with intuition regarding the *long-run* pre-trends in women's health across regions. However, it notably fails to provide us with region-specific *short-run* trends in women's health across regions. Which is why I future drafts we will also look at child's birthweight for infants born just before 2008, as an alternative measure to determine if pre trends hold in the short run.

dummies ($\mathrm{KBK_j}$, DP_j) and the post policy time period dummy ($post_t$) unnecessary. The main coefficient of interest in our specification are the difference-in-differences coefficient - β_1, β_2 . If parallel trends hold, these coefficients measures the effect of the 2008 policy change on BMI for women residing in the KBK and non-KBK drought-prone districts, respectively relative to the omitted region. In this specification the omitted region are all the districts that are neither KBK and nor drought-prone.

The individual characteristics include women's age, age squared, years of schooling, number of kids ever born, age at first union/gauna, and a dummy that equals one if the respondent women was pregnant at the time of survey. Household level controls include caste and religion dummies, rural residence, and access to improved drinking water and toilet. A complete description of these controls is given in **Table A3**. District fixed effects are included to account for time invariant unobsevarbles that vary across districts but could be influencing women's BMI whereas month-year dummies help control for seasonality in women's anthropometry data. Differences in month wise data collection across the two survey rounds makes their inclusion especially important since more data in round 2 was collected during months when women's BMI was relatively low. **Figure A1** shows that in IHDS-1, nearly 57% of the data was collected over January and February, a time when the BMI-month relationship was slightly increasing or was nearly flat. On the other hand, in round 2, data collection picked pace only from the month of March and corresponds to the time when women's BMI was starting to fall, driven by a sudden decline in women's BMI in Other districs and a gradual decline in the KBK and drought prone districts (**Figure A2**). This pattern suggests that not accounting for month year dummies could lead to underestimation of difference-in-differences estimates for KBK and non-KBK drought prone districts relative to other regions.

Although drought prone status is assigned at the block level, data limitations force us to define region dummies at the district level. Therefore it is likely that we are misclassifying some women by assigning them the wrong region dummy. For example, a woman residing in a non-drought-prone block could be classified as belonging to a non-KBK drought prone region in our sample if her district of residence has a very high coverage intensity (>=50%). Similarly, a women from a drought prone block could be assigned to Other regions if the district level coverage intensity is very low (<50%). Assignment of baseline below poverty line women to wrong subgroups could dilute the reform impact and cause us to under estimate the results for that group. This however should not make a difference for baseline above poverty line women since for them the reform impact takes at KBK vs non-KBK level which is a district level classification. To determine the effect of this misclassification on our impact estimates, we estimate equation 2 for a restricted sample of districts. We only consider those districts where either all of the blocks in a district were given drought prone status or where none of the blocks in a district were given drought prone status. **Table A2** provides detailed information on which districts have "full" or "none" coverage. Any district that consisted of some drought prone and some non-drought prone blocks (such as Kalahandi, Gajapati etc.) were dropped from this restricted sample.

Lastly, we also estimate equation 1 and 2 separately for women subgroups who were underweight, normal weight and overweight at baseline, irrespective of their ration card holding status. This is motivated by Odisha government's poor track record in targeting right beneficiaries under PDS. The state government has been frequently criticized for substantial inclusion errors resulting from the undeserving and ineligible households holding below poverty line ration cards. So, even if regression results by baseline ration card status shows improvements in above and below poverty

line women's BMI, it is possible that the households benefitting from the policy change are not the truly vulnerable, low income, food insecure households that the program wants to target. This point is driven home by the kernel density **Figures A3** for BMI of baseline above and below poverty line in 2004-05. Even though BMI density for below poverty line women lies to the left of above poverty line women, the spread of the density shows that a substantial proportion of below poverty line women fall in the normal or overweight range (nearly 63%). Approximately 22% had BMI greater than 21.75 kg/m and were on the higher end of the normal weight spectrum or in the overweight range. Therefore, it is also necessary to ascertain how program affected BMI across different weight groups to determine the true beneficiaries. We use women's BMI to determine malnutrition among adults. WHO recommends five health weight classification but for analysis we consider three weight ranges - underweight category includes women with BMI less than 18.5 kg/m^2, normal weight includes women with BMI greater or equal to 18.5 kg/m^2 but less than 25.0 kg/m^2, and overweight includes women with BMI greater than or equal to 25.0 kg/m^2.[18]

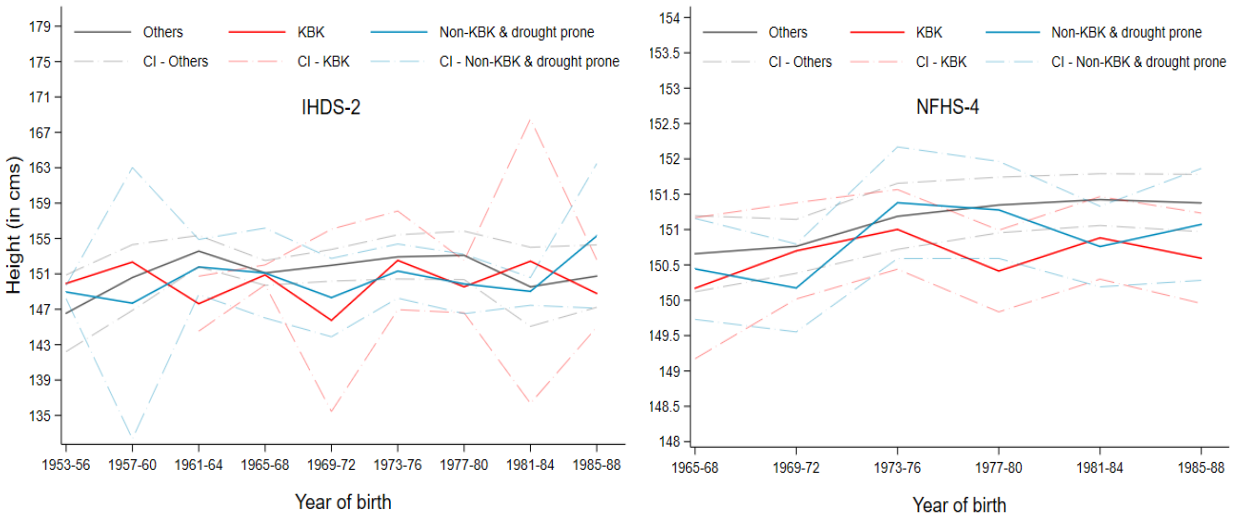
5. Results

5.1. Testing Pre trends

Figure 2 and Figure 3 show the trends for height of women who are above and below poverty line respectively. For both the ration card holding group the parallel trends assumption holds irrespective of the data source used. However, we need to be slightly careful when interpreting the resuls for above poverty line women. Unlike IHDS surveys where respondents were specifically asked to report the type of ration card held, NFHS-4 only asked its respondents a yes or no question on whether they had a below poverty line card. This is probably because by 2013, national food security act had been passed which nationally replaced the above and below poverty line classifications with a single priority category. This change was to be implemented across all states by 2015. Thus, the pre trends depicted on the right panel in **Figure 2Error! Reference source not found.** using NFHS-4 data pertains to non-below poverty line card holders and possibly includes households that never held a ration card along with households that did previously hold an above poverty line ration card. More detailed parallel trends regression results can be found in **Table A4**.

[18] According to WHO 2006 guidelines, BMI can be used to determine which of the five health weight classification one falls in - Moderate and severe thinness (BMI < 17.0 kg/m^2), Underweight (BMI ≥ 17.0 kg/m^2 and < 18.5 kg/m^2), Normal weight (BMI ≥ 18.5 kg/m^2 and < 25.0 kg/m^2), Overweight (BMI ≥ 25.0 kg/m^2 and < 30.0 kg/m^2) and Obesity (BMI ≥ 30.0 kg/m^2).

Figure 2: Pre trends in height of Above-Poverty-Line adult women (at least 20 years old at the time of policy change), by year of birth across the three spatial groups



Note: The left panel shows trends in height of women belonging to households holding Above-Poverty-Line ration card as reported in IHDS-2 (2011-12) data. Unlike IHDS-2, NFHS-4 only asked respondents a yes or no question on whether they had a below poverty line card.The right panel thus shows trends in heights of women who belong to Non-Below-Poverty-Line households as reported in NFHS-4 (2015-16) data.

Figure 3: Pre trends in height of below poverty line adult women (at least 20 years old at the time of policy change), by year of birth across the three spatial groups

Note: The left panel shows trends in height of women belonging to households holding Below-Poverty-Line ration card as reported in IHDS-2 (2011-12) data. The right panel shows trends in heights of women who belong to Below-Poverty-Line households as reported in NFHS-4 (2015-16) data.

Figure 4: Pre trends in height of underweight, normal weight and overweight (at least 20 years old at the time of policy change), by year of birth across the three spatial groups

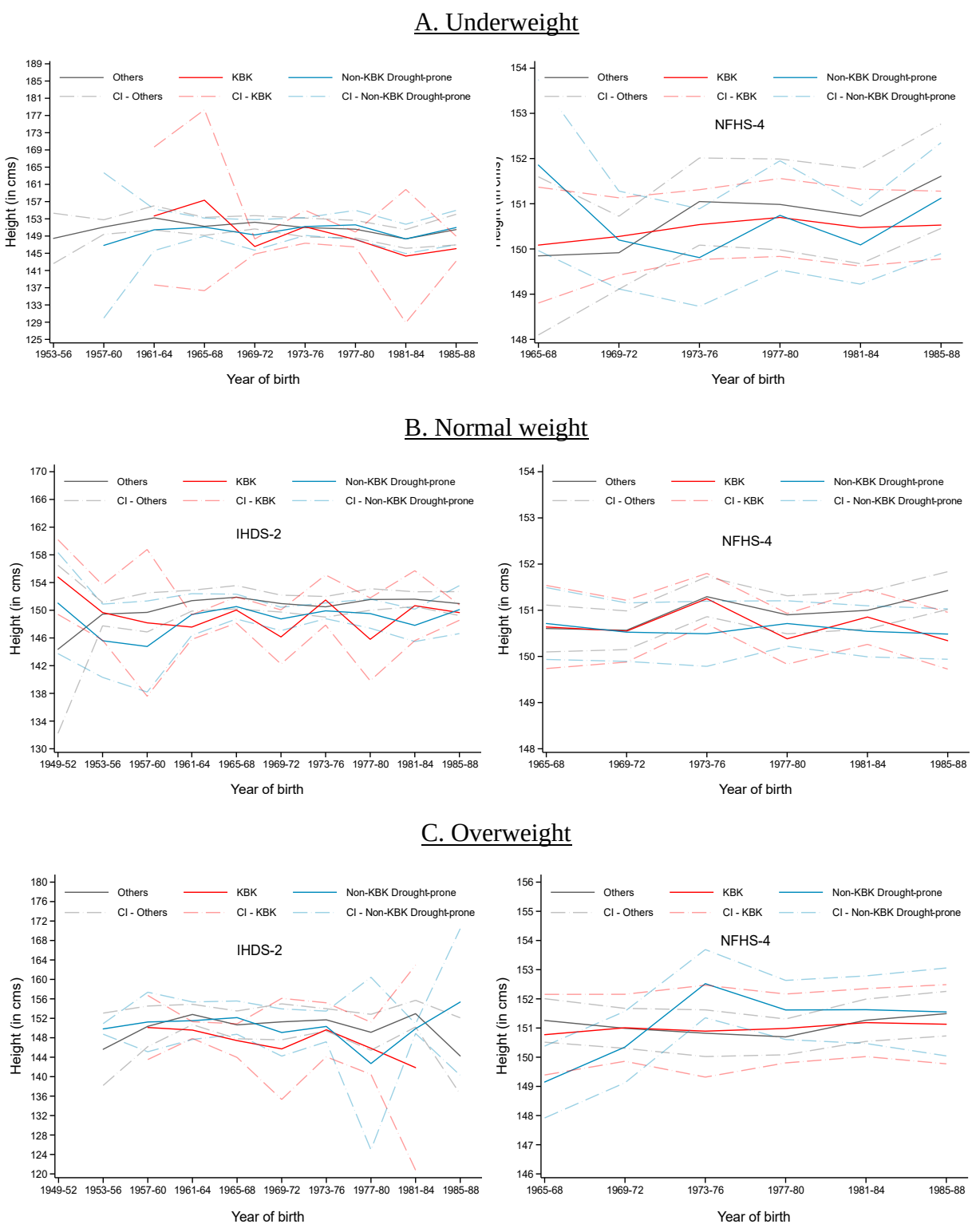


Figure 4 shows the trends for height of women belonging to different BMI categories, by year of birth across KBK, non KBK drought prone and other districts. When looking at IHDS results, we see that for each BMI category, the trends in average height of women by year of birth is flat and appear parallel across the three spatial groups. This observation is consistent with the pre trend regression results given in columns 2, 4, and 6 of **Table A6**. The β_2, β_3 coefficients from regression equation 1 are statistically insignificant for underweight, normal weight and overweight women.

However, NFHS-4 data tells a different story. From the figures, pre trends for KBK and Others districts appear non-parallel for normal weight categories. Avergage height of women across different birth cohorts shows a slightly upward trend, while the trend in KBK remains flat. This observation is supported by the regression estimates generated using NFHS-4 data, given in columns 1, 3, and 5 of **Table A6**. The interaction of women's age and KBK region dummy is positive and significant for the normal weight category women, implying that height is higher for older women in KBK districts relative to reference districts. Similarly, the interaction of women's age and non KBK drought prone region dummy is also positive and significant at 10% for women belonging to underweight and normal weight categories. Although non parallel, the positive coefficient suggests that if statistically significant positive program impacts are found, it would be an underestimate. The only case where the violation of parallel trend is worrying is for overweight women, where β_3 coefficient for non KBK drought prone districts is in fact negative and statistically significant at 10% level.

5.2 Main Results

A) By Baseline Ration Card holding

Table 3 contains the difference-in-differences regression estimates for baseline above poverty line women. While women's BMI shows a general improvement, surprisingly we do not find any evidence that BMI of above poverty line women in KBK improved more than those living in non-KBK non drought prone districts post 2008 (model 1). The DID coefficient estimate for non-KBK drought prone districts relative to the reference districts is also statistically insignificant but expected since expansion of PDS rice subsidy to APL housheholds was limited to above poverty line household in KBK districts only. To test the robustness of our results we run regression 2 on winsorized and trimmed BMI outcome in model 2 and model 3 respectively. In case of winsorized BMI outcome, we replace top one percentile of the BMI distribution with the BMI value at the 99th percentile, whereas in case of trimmed BMI we drop these top one percent observations from the analysis. The results does not change for either of the regions.

There are three possible explanations for the surprising null result in KBK districts despite substantial expansion in effective subsidy relative to other districts. Firstly, there was truly no impact. Secondly, not enough time had passed since policy change for visible impacts on women's BMI to show up. Lastly, it is possible that the movement of baseline above poverty line card holders to other ration card groups by 2011 could be diluting the impacts. A deeper examination shows that of 327 baseline above poverty line card holders, 48% retained their above poverty line card status, 27% became below poverty line card holders and 25% held neither by 2011. We do not know when this cross movement happened as this information was not collected, but this cross movement could be diluting the impact estimates as non-card holders are not entitled to PDS rice at subsidized rates. We therefore expect excluding baseline above poverty line women who held

no card at endline from our sample to improve the DID coefficient estimate for KBK. While rerunning regression 2 for this new subsample does improve the magnitude, it remains statistically insignificant (model 4, **Table A7**). Only for women holding above poverty ration card at both baseline and endline, do we see a 1.79kg/m^2 greater increase in BMI in KBK relative to not KBK and not drought prone districts. This positive impact is strongly significant at 1% level (model 5, **Table A7**).

Table 3: Difference-in-Differences regression results for baseline Above-Poverty-Line women

	(1) BMI	(2) BMI	(3) BMI
KBK X Post	0.192	0.280	0.371
	(0.874)	(0.814)	(0.795)
Non-KBK Drought-prone X Post	-0.155	-0.501	-1.011
	(0.837)	(0.679)	(0.611)
Intercept	18.960***	19.476***	20.231***
	(4.948)	(4.904)	(4.912)
Observations	648	648	639
R sq.	0.310	0.324	0.313
Household Controls	Y	Y	Y
Individual Controls	Y	Y	Y
Month X Year Fixed Effects	Y	Y	Y
District Fixed Effects	Y	Y	Y
Women's BMI:	Unchanged	Winsorized	Trimmed

Data Source: Panel IHDS-1 and IHDS-2 women's data. IHDS surveys include HHs sampled from 26 out of 30 districts in Odisha. To ensure our results are not distorted by outlier values, in Col 2 we replace BMI values lying in the top one percentile of the distribution with the 99th percentile value whereas in Col 3 we drop these top one percent observations. In Cols 1-3 our sample includes all women who were Above -Poverty-Line card holders at baseline. Jacknifed standard errors in parentheses * p < .1, ** p < .05, *** p < .01

Table 4: Difference-in-Differences regression results for baseline Below-Poverty-Line women

	(1) BMI	(2) BMI	(3) BMI
KBK X Post	1.635***	1.577***	1.174**
	(0.486)	(0.491)	(0.562)
Non-KBK Drought-prone X Post	-0.074	-0.047	0.022
	(0.525)	(0.521)	(0.528)
Intercept	12.601***	12.894***	13.932***
	(3.431)	(3.289)	(3.016)

Observations	1341	1341	1332
R sq.	0.257	0.255	0.234
Household Controls	Y	Y	Y
Individual Controls	Y	Y	Y
Month X Year Fixed Effects	Y	Y	Y
District Fixed Effects	Y	Y	Y
Women's BMI:	Unchanged	Winsorized	Trimmed

Data Source: Panel IHDS-1 and IHDS-2 women's data. IHDS surveys include HHs sampled from 26 out of 30 districts in Odisha. To ensure our results are not distorted by outlier values, in Col 2 we replace BMI values lying in the top one percentile of the distribution with the 99th percentile value whereas in Col 3 we drop these top one percent observations. In Cols 1-3 our sample includes all women who were Below-Poverty-Line card holders at baseline. Jacknifed standard errors in parentheses * p < .1, ** p < .05, *** p < .01

Table 4 contains the difference-in-differences regression estimates for baseline below poverty line women. We find strong positive policy change impacts on the BMI of baseline below poverty line card holders residing in the KBK region. BMI of Baseline below poverty women in KBK districts increased by 1.635 kg/m^2 more than the women residing in Non-KBK and non drought prone districts (**Column 1, Table 4**). This result is strongly significant at 1% level and is robust even when we run regression on winsorized and Trimmed BMI outcomes. Again expectedly, we do not see any improvement in women's BMI in non-KBK drought prone districts compared to others.

As explained in **section 4**, we also estimate equation 2 for a restricted sample of districts to test if misclassification could be affecting our impact estimates. We expect causal estimates to be stronger for baseline below poverty line women but do not expect results for baseline above poverty line women to change. We find that for baseline below poverty line women, dropping districts that create a spillover like effect, increases the DID coefficient for KBK from 1.635 kg/m^2 to 1.642 kg/m^2 (model 7, **Table A7**). However, unexpectedly at the same time we also see that for baseline above poverty line women, the DID coefficient for KBK becomes statistically significant at 10 level and indicates that women's BMI saw a higher decline of 2.362 kg/m^2 relative to other regions (model 6, **Table A7**). For non- KBK drought prone regions, results remain statistically insignificant. The parallel trend results for this restricted sample mostly hold and is given in **Table A5**. We see non parallel trends only for KBK, irrespective for card status, when using NFHS4 data. However, the positive coefficient for the KBK and age interaction term suggests that our causal estimates would be an under estimate.

B) By Baseline BMI Category

The strong positive impact on women's BMI for baseline poverty line card holders in KBK districts suggests that the 2008 policy change benefitted the more vulnerable sections of the society. However, as explained in section 4, Odisha government's track record of mistargeting beneficiaries under PDS, could have resulted in PDS reform benefits not accruing to the truly vulnerable, low income, food insecure housheolds. Which is why we run regression 2 for women who were underweight, normal weight and overweight at baseline and see whether reform had a differential impact on their BMI across KBK, non KBK drought prone and Other districts. DID regression results for the three BMI categories is given in **Table 5**.

Table 5: Difference-in-Differences regression results by baseline BMI categories

	(1) BMI	(2) BMI	(3) BMI
KBK X Post	1.502***	0.535	3.440*
	(0.479)	(0.611)	(1.749)
Non-KBK Drought-prone X Post	-1.014	0.058	-1.653
	(0.662)	(0.491)	(1.812)
Intercept	17.304***	14.916***	22.991
	(2.696)	(3.684)	(15.626)
Observations	814	1477	223
R sq.	0.249	0.276	0.341
Household Controls	Y	Y	Y
Individual Controls	Y	Y	Y
Month X Year Fixed Effects	Y	Y	Y
District Fixed Effects	Y	Y	Y
Women's BMI Category	Under weight	Normal weight	Over weight

Data Source: Panel IHDS-1 and IHDS-2 women's data. IHDS surveys include HHs sampled from 26 out of 30 districts in Odisha. In Col 4, 5 and 6 we report regression results for women who at baseline were underweight (BMI < 18.5 kg/m^2), normal weight (BMI >= 18.5 kg/m^2 & BMI < 25 kg/m^2) and over weight (BMI >= 25.0 kg/m^2) respectively. Jacknifed standard errors in parentheses * p < .1, ** p < .05, *** p < .01

For baseline underweight women, KBK women's BMI shows 1.502 kg/m^2 greater increase than BMI of women residing in other districts. This result is robust and strengthens to 1.857 kg/m^2 differential improvement when we restrict analysis to those districts where either all or none of the blocks hold drought prone status (col 3, **Table A8**). Moreover, the DID coefficient for KBK is insignificant for baseline normal weight women. A slightly worrying result is the weakly significant increase of 3.440 kg/m^2 in average BMI of baseline overweight women residing in KBK districts relative to reference group. But this result does not hold when we conduct analysis with restricted group of districts in **Table A8**.

We also don't see any impact for women residing in non KBK drought prone districts relative to Others, irrespective of the BMI category considered. But this changes for baseline overweight women when we conduct analysis using restricted group of districts. Baseline overweight women in non KBK drought prone regions experience a decline in average BMI of 6.359 kg/m^2 compared to the reference group, significant at 5% level. While this is a favourable result, we need to explore why this might be happening.

C) Mechanisms

We now examine the mechanisms through which the improvement in BMI might have taken place for baseline below poverty line women in KBK regionho. **Table 6** presents results for how rice consumption was affected due to the PDS reform. Column 1 shows the impact of reform on the probability of buying PDS rice in last 30 days whereas column 2 shows the impact on total quantity

of PDS rice purchased in last 30 days. Results indicate that PDS reform made it 35.3% more likely for baseline above poverty line women in KBK to purchase PDS rice than those residing in non-KBK and non-drough prone regions. These women from KBK districts also purchased 8.57 kgs more rice that women in other districts post policy change. Given that the expansion of PDS subsidy to above poverty line women was carried out in KBK region only, this result gives us confidence that the program was implemented properly. But although subsidy expansion incentivized above poverty line households to increase consumption of PDS rice, the total consumption of rice did not increase diffferentially. With the exception of sugar, we also don't see a differentially higher increase (in KBK and non-KBK drought prone districts) in consumption of other PDS items such as wheat and kersone nor total consumption or expenditure on most food items including pulses, meat/chicken/fish, eggs, milk, processed foods, vegetables, and fruits (**Table A10, Table A11**). Any significant change that we do see some cases shows a higher decline in total consumption or expenditure of these food items in KBK and non-KBK drought prone districts. This lack of significant increase in consumption perhaps explains why we see no improvement in women's BMI for baseline poverty line women women in either of these spatial groups.

Table 6: Difference-in-Differences regression results for rice consumption (In kgs, in last 30 days), by baseline ration card status

	(1) =1 if PDS rice purchased	(2) Qty of PDS rice purchased	(3) Qty of rice consumed	(4) Per capita rice consumed
Baseline Above-Poverty-Line				
KBK X Post	0.353**	8.567**	-9.156	1.080
	(0.145)	(3.819)	(10.479)	(1.456)
Non-KBK Drought-prone X Post	-0.011	-2.610	9.866	2.151
	(0.152)	(6.009)	(12.615)	(1.421)
Observations	648	648	648	648
R sq.	0.410	0.386	0.246	0.410
Baseline Below-Poverty-Line				
KBK X Post	-0.067	0.892	-2.539	-1.569*
	(0.157)	(3.476)	(5.039)	(0.840)
Non-KBK Drought-prone X Post	-0.163	-3.879	0.550	0.295
	(0.133)	(3.382)	(6.154)	(1.081)
Observations	1341	1341	1341	1341
R sq.	0.282	0.315	0.243	0.282
Household Controls	Y	Y	Y	Y
Individual Controls	Y	Y	Y	Y
Month X Year Fixed Effects	Y	Y	Y	Y

District Fixed Effects	Y	Y	Y	Y

Data Source: Panel IHDS-1 and IHDS-2 women's data. Jacknifed standard errors in parentheses * p < .1, ** p < .05, *** p < .01

However, surprisingly the consumption results for baseline below poverty line women are very similar and fail to explain the strong BMI improvements seen in the KBK region. Unlike baseline Above poverty line women, we see no differential impact on binary and continuous measures of purchase of PDS rice in KBK and non KBK drought prone regions relative to other districts. We had initially hypothesized that subsidy expansion could have led to improved PDS functioning. If this was indeed the case then we should have seen an improvement in PDS rice consumption which is missing and leads us to believe that subsidy expansion had income effects that could explain BMI improvements. But that hypothesis also fails to hold. With the exception of PDS sugar, for all other consumption and expenditure on various food items we either have a null result or we see statistically higher decline in expenditure/consumption measure in KBK districts relative to the reference group. Another possible explanation for significant positive BMI impacts accruing to KBK region could be that women's BMI in KBK region was very low to begin with and thus any small improvement would be statistically significant. Density graphs of women's BMI by baseline card status and region of residence shows that while women's BMI was lower in KBK regions for both above and below poverty line women prior to 2008 and could partially explain the results, the differences in magnitude don't seem to be large enough to justify the strong impacts discussed in the previous section (**Figure A4, A5**).

6. Conclusion

We exploit a 2008 natural experiment conducted in Odisha, an eastern state of India, to study the impact of universalization on women's nutrition. We use the difference-in-differences approach to examine the heterogenous impact of the reform on different ration card holding groups and different spatial groups. While we find no evidence of improvement in women's BMI for above poverty line women residing in KBK districts relative to others, we do find strong evidence of a positive improvement of women's BMI for below poverty line women residing in KBK districts relative to other regions. However, surprisingly the improvement in nutrition outcomes is not supported by improvement in consumption of various food items. Future analysis will focus on unearthing the reasons behind the strong nutrition impacts seen in KBK districts

7. Reference

1. Aggarwal, A. (2011). The PDS in rural Orissa: against the grain?. Economic and Political Weekly, 21-23.
2. Bhuria, D.S. (2004). Report of the Scheduled Areas and Scheduled Tribes Commission. New Delhi: Government of India.
3. Desai, Sonalde, Amaresh Dubey, B.L. Joshi, Mitali Sen, Shariff, Abusaleh, and Reeve Vanneman. India Human Development Survey (IHDS) [Computer file]. ICPSR22626-v2. University of Maryland and National Council of Applied Economic Research, New Delhi [producers], 2007. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2009-05-01.

4. Desai, Sonalde, Amaresh Dubey, and Reeve Vanneman. India Human Development Survey-II (IHDS-II) [Computer file]. University of Maryland and National Council of Applied Economic Research, New Delhi [producers], 2015. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor].
5. Drèze, J., and Khera, R. (2011): "PDS Leakages: The Plot Thickens", The Hindu, 12 August.
6. Drèze, J., and Khera, R. (2012). "A Bill that asks too much of the poor", The Hindu, 16 August. https://www.thehindu.com/opinion/lead/a-bill-that-asks-too-much-of-the-poor/article3859455.ece
7. Drèze, J., & Khera, R. (2015). Understanding leakages in the public distribution system. Economic and Political Weekly, 39-42.
8. Dutta, P., Howes, S., & Murgai, R. (2010). Small but Effective: India's Targeted Unconditional Cash Transfers. Economic & Political Weekly, 45(52), 63.
9. Government of Odisha. (2014). *Odisha Economic Survey 2013-14*. https://pc.odisha.gov.in/sites/default/files/2020-03/Economic_Survey_2013-14.pdf
10. https://repository.tribal.gov.in/handle/123456789/73889?viewItem=browse
11. Government of Odisha. (2020). Making of a Food Secure Odisha: Converging Transparency, Technology & Teamwork for Time-Bound transformation. http://www.foododisha.in/Download/foodsecure.pdf
12. Government of Orissa. (2005). *Economic Survey 2004-05: Chapter 16 Prices and Public Distribution*. https://pc.odisha.gov.in/sites/default/files/2020-03/eco-16.pdf
13. Government of Orissa. (2006). *Economic Survey 2005-06: Chapter 16 Prices and Public Distribution.* https://pc.odisha.gov.in/sites/default/files/2020-03/eco-16_0.pdf
14. Government of Orissa. (2007). *Economic Survey 2006-07: Chapter 16 Prices and Public Distribution.* https://pc.odisha.gov.in/sites/default/files/2020-03/eco-16CA.pdf
15. Government of Orissa. (2008). *Economic Survey 2007-08: Chapter 16 Prices and Public Distribution*. https://pc.odisha.gov.in/sites/default/files/2020-03/eco-16CFA.pdf
16. Government of Orissa. (2009). *Economic Survey 2008-09: Chapter 16 Prices and Public Distribution*. https://pc.odisha.gov.in/sites/default/files/2020-03/eco-16CFA_0.pdf
17. Khera, R. (2011). Revival of the public distribution system: evidence and explanations. Economic and Political Weekly, 46(44/45), 36-50.
18. Khera, R, and Somanchi, A. (2020). "A review of the coverage of PDS" *Ideas for India*, https://www.ideasforindia.in/topics/environment/a-review-of-the-coverage-of-pds.html
19. Kishore, A., Chakrabarti, S., 2015. Is more inclusive more effective? The ''New Style" public distribution system in India. Food Policy 55, 117–130.
20. Kochar, A., 2005. Can targeted food programs improve nutrition? An empirical analysis of India's public distribution system. Econ. Dev. Cult. Change 54 (1), 203–235.
21. Kohli, N., Avula, R., van den Bold, M., Becker, E., Nisbett, N., Haddad, L., & Menon, P. (2017). Reprint of" What will it take to accelerate improvements in nutrition outcomes in Odisha? Learning from the past". Global food security, 13, 38-48.
22. Krishnamurthy, P., Pathania, V., Tandon, S., 2014a. Food price subsidies and nutrition: evidence from state reforms to India's public distribution system. In: The Agricultural & Applied Economics Association's 2014 AAEA Annual Meeting.
23. Kumar, A., Parappurathu, S., Babu, S. C., & Joshi, P. K. (2017). Can better governance improve food security? An assessment of the public food distribution system in Odisha, India. *Food security, 9*(6), 1433-1445.

24. Ministry of Tribal Affairs. (2016). State Wise ITDP & ITDA Area. https://stcmis.gov.in/Guidelines.aspx
25. Ministry of Rural Development. (1994). Report of the Technical Committee on Drought Prone Areas Programme and Desert Development Programme.
26. Perkins, J. M., Subramanian, S. V., Davey Smith, G., & Özaltin, E. (2016). Adult height, nutrition, and population health. Nutrition reviews, 74(3), 149-165.
27. Planning Commission. (2002). Action Taken Report on The Revised Long-Term Action Plan for the KBK Districts of Orissa. Government of India, New Delhi
28. Rahman, A. (2016). Universal food security program and nutritional intake: Evidence from the hunger prone KBK districts in Odisha. Food Policy, 63, 73-86.
29. Sen, A. (2011). Why not a universal food security legislation?. Economic and Political Weekly, 38-47.
30. The Odisha Gazette. (2016). The Odisha Public Distribution System (Control) Order, 2016 Notification. Food Supplies & Consumer Welfare Department. http://foododisha.in/Download/OPDS-Control-Order-2016.pdf
31. Wadhwa, D. (2009). Justice Wadhwa Committee on Public Distribution system in Orissa.

8. Appendix

Table A1: PDS Entitlement Prices for rice, before and after the 2008 price reform (In Rs/Kg)

	Above-Poverty-Line			Below-Poverty-Line		
	KBK	Non-KBK & drought-prone	Other	KBK	Non-KBK & drought-prone	Other
2004-05	6.3	—	—	5.31*	5.31*	6.3
2011-12	2	—	—	2	2	2

Notes: Prices are given in 2005 Rs/Kg for 2004/5, and in 2011 Rs/Kg in 2011-2012. "KBK" indicates all KBK districts, some of which also hold drought-prone blocks. ₩"Non-KBK and drought-prone" indicates all drought-prone blocks within non-KBK districts. "Other" indicates all blocks within non-KBK districts that were not designated as drought-prone. *Below-Poverty-Line households in KBK districts and in non-KBK drought-prone blocks were given their first 16 kgs at Rs 4.75 per kg and their remaining 9 kgs at Rs 6.30 per kg (Government of Orissa, 2005). Thus, the effective price paid for the full entitlement of 25 kg was Rs 5.308 per kg.

Table A2: Districtwise details on blocks where Below-Poverty-Line card holders were provided PDS rice at dual prices before 2008

Treatment Regions	Total Blocks	# blocks having dual pricing system	Coverage (% of total blocks)	Coverage Intensity (% of total blocks)
		KBK Districts		
Balangir (Bolangir)	14	8	57.14	>= 50%
Kalahandi	13	6	46.15	< 50%
Koraput	14	14	100.00	Full
Malkangiri	7	7	100.00	Full
Nabarangpur	10	10	100.00	Full
Nuapada	5	4	80.00	N/A
Rayagada	11	11	100.00	Full
Subarnapur (Sonepur)	6	0	0.00	None
		Non-KBK & Drought Prone Districts		
Bargarh	12	6	50.00	>= 50%
Baudh	3	2	66.67	>= 50%
Gajapati	7	5	71.43	>=50%
Kandhamal	12	12	100.00	Full
Kendujhar	13	10	76.92	>= 50%
Mayurbhanj	26	26	100.00	Full
Sundargarh	17	17	100.00	Full
		Other Districts		
Angul	8	0	0.00	None
Balasore (Baleshwar)	12	1	8.33	< 50%
Bhadrak	7	0	0.00	None
Cuttack	14	0	0.00	None
Debagarh (Deogarh)	3	0	0.00	N/A
Dhenkanal	8	0	0.00	None
Ganjam	22	0	0.00	None
Jharsuguda	5	0	0.00	None
Jajpur	10	0	0.00	None
Jagatsinghapur	8	0	0.00	N/A
Kendrapara	9	0	0.00	N/A
Khordha (Khurda)	10	0	0.00	None
Nayagarh	8	0	0.00	None
Puri	11	0	0.00	None
Sambalpur	9	3	33.33	< 50%
Total	314	142		

Note: Districts marked as N/A indicate regions that were not sampled in the IHDS and therefore could not be included in the analysis.

Figure A1: Data collection in different months and BMI and interview month relationship, by survey round

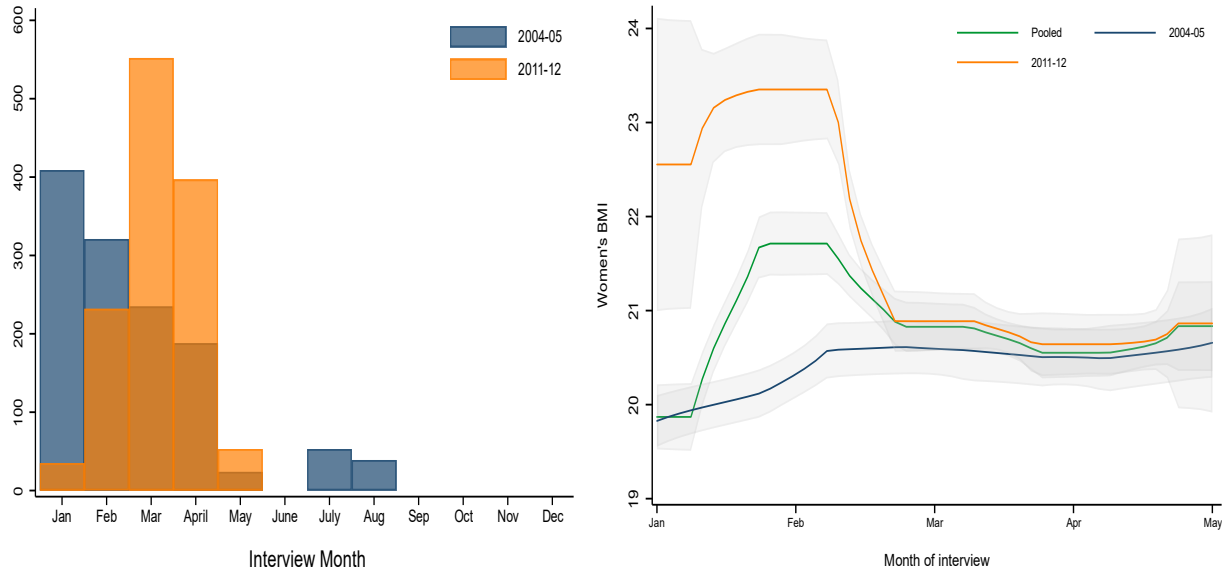


Figure A2: Data collection and BMI-interview month relationship, by survey round and regions

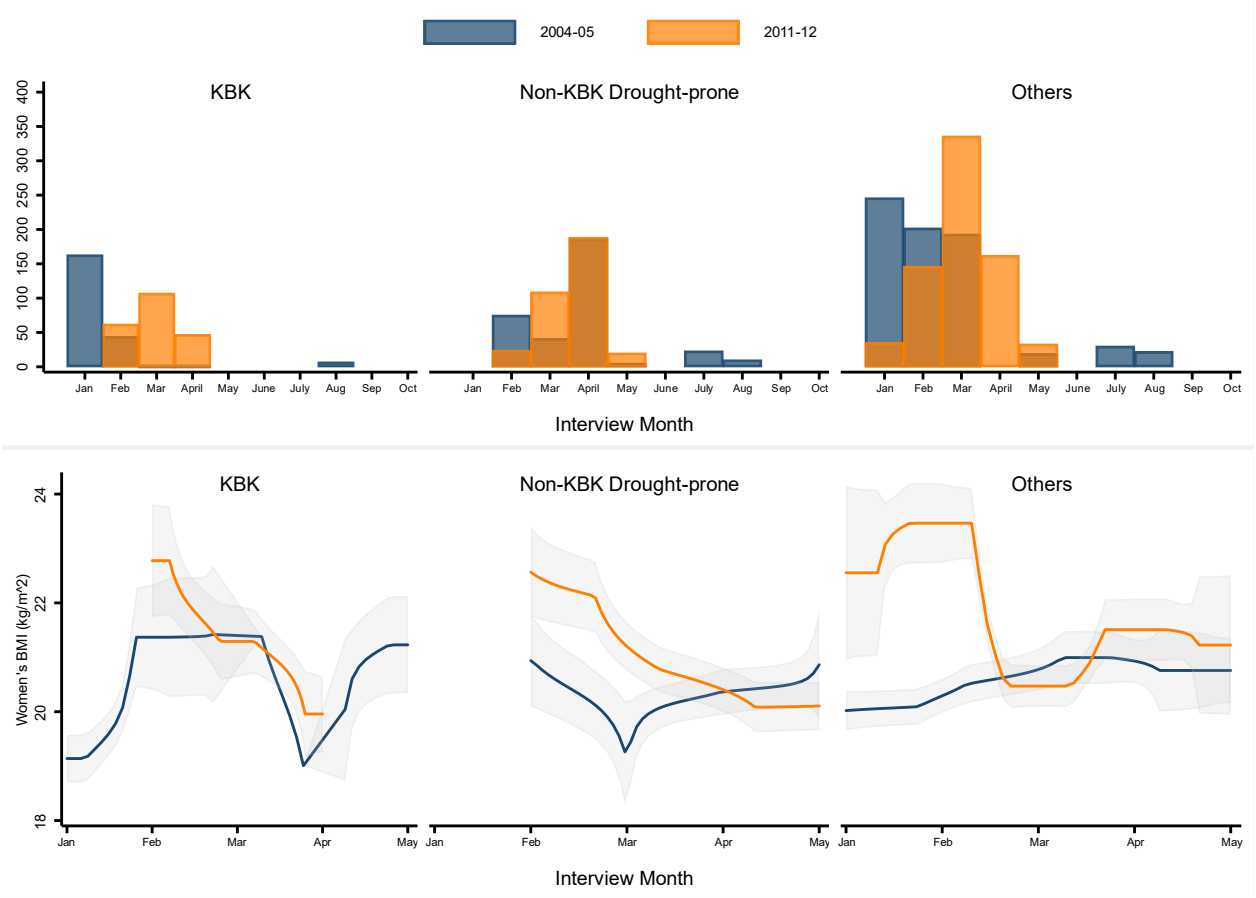


Table A3: List of controls used in analysis

Outcome	
Adult women's BMI	BMI = kg/(m)^2
Individual Controls	
Age	Woman's age (in years) at the time of survey
Age squared	Woman's age squared
Education	Years of schooling (top-coded at 16 for women with bachelor's degree and above)
# kids ever born	Number of kids ever born to a woman
Age at first gauna	Age (in years) at first union or gauna
=1 if currently pregnant	Binary variable that takes value one if woman was pregnant at the time of survey
Housheold Controls	
Caste: Scheduled Tribe	Binary variable that takes value one if household head is a member of Scheduled Tribe (ST)
Caste: Scheduled Caste	Binary variable that takes value one if household head is a member of Scheduled Caste (SC)
Caste: Other backward caste	Binary variable that takes value one if household head is a member of Other Backward Caste (OBC)
Religion: Hindu	Binary variable that takes value one if household head is Hindu
Religion: Muslim	Binary variable that takes value one if household head is Muslim
Rural	Binary variable that takes value one if woman resides in rural area
Improved Water	Binary variable that takes value one if woman lives in a household that has access to improved source of drinking water (piped, tubewell, handpump, covered well, tanker truck, rainwater, and bottled water)
Improved Toilet	Binary variable that takes value one if woman lives in a household that has access to improved toilet (flush toilet and semi flush/septic tank latrine)*

* Note: Question on the toilet facility was asked slightly different in IHDS 1 (2004-05). Instead of semi flush/septic tank latrine option, the questionnaire has ventilated improved pit latrine option.

Figure A3: Kernel density of BMI of baseline Above and Below-Poverty-Line women in survey round 1 (2004-05)

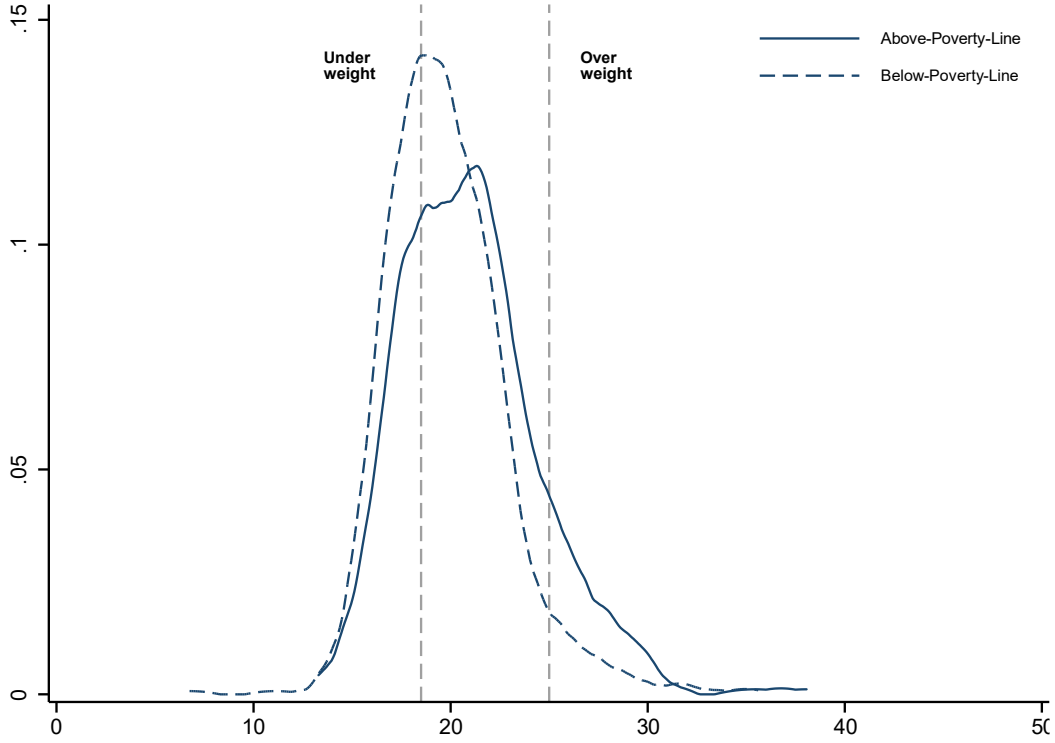


Table A4: Pre trend check for height of women born between 1949 and 1988 for all districts by ration card status

	(1) Height	(2) Height	(3) Height	(4) Height
KBK X Age	0.032	0.080	0.033	-0.058
	(0.031)	(0.077)	(0.023)	(0.153)
Non-KBK drought prone X Age	0.041	-0.009	0.011	-0.034
	(0.032)	(0.065)	(0.028)	(0.116)
KBK	-1.213	-5.560*	-1.809**	0.983
	(1.227)	(3.221)	(0.906)	(6.755)
Non-KBK drought prone	-1.709	-0.571	-0.712	0.017
	(1.241)	(2.708)	(1.106)	(4.790)
Current Age	-0.027	0.016	-0.041***	0.008
	(0.021)	(0.042)	(0.013)	(0.080)
Intercept	151.620***	150.070***	152.727***	151.122***
	(0.834)	(1.862)	(0.518)	(3.543)
Observations	7816	880	10709	441
R sq.	0.001	0.045	0.003	0.010
Data Source used:	NFHS4	IHDS2	NFHS4	IHDS2
Sample women:	Below-Poverty-Line	Below-Poverty-Line	Non-Below-Poverty-Line	Above-Poverty-Line

Note: Unlike IHDS2 which asked detailed question on the type of ration card held, NFHS4 only asked respondents a yes or no question on whether they had a below poverty line card. Thus, in Col 3, we report parallel trend regressions done using NFHS4 for Non-Below-Poverty-Line women which could potentially include women not holding any ration card. In Col 4, we report parallel trend regressions done using IHDS2 for Above-Poverty-Line women. Jacknifed Standard errors in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$

Table A5: Pre trend check for height of women born between 1949 and 1988 in districts that either have all or none of blocks holding drought prone status (restricted sample), by ration card status

	(1) Height	(2) Height	(3) Height	(4) Height
KBK X Age	0.057*	0.145	0.049*	-0.530
	(0.034)	(0.144)	(0.028)	(0.361)
Non-KBK drought prone X Age	0.058	-0.037	0.027	-0.091
	(0.040)	(0.085)	(0.042)	(0.166)
KBK	-2.886**	-7.788	-2.658**	20.557
	(1.314)	(5.967)	(1.107)	(14.829)
Non-KBK drought prone	-2.678*	1.166	-1.519	1.824
	(1.498)	(3.391)	(1.672)	(6.228)
Current Age	-0.024	0.031	-0.038***	0.038
	(0.021)	(0.054)	(0.014)	(0.094)
Intercept	151.642***	149.446***	152.691***	149.827***
	(0.816)	(2.345)	(0.516)	(4.109)
Observations	7816	5061	551	7969
R sq.	0.001	0.003	0.048	0.004
Data Source used:	NFHS4	IHDS2	NFHS4	IHDS2
Sample women:	Below-Poverty-Line	Below-Poverty-Line	Non-Below-Poverty-Line	Above-Poverty-Line

Note: Unlike IHDS2 which asked detailed question on the type of ration card held, NFHS4 only asked respondents a yes or no question on whether they had a below poverty line card. Thus, in Col 3, we report parallel trend regressions done using NFHS4 for Non-Below-Poverty-Line women which could potentially include women not holding any ration card. In Col 4, we report parallel trend regressions done using IHDS2 for Above-Poverty-Line women. Jacknifed Standard errors in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$

Table A6: Pre trend check for height of women born between 1949 and 1988 for all districts, by women's BMI category

	(1) Height	(2) Height	(3) Height	(4) Height	(5) Height	(6) Height
KBK X Age	0.066	0.127	0.049**	-0.006	0.002	0.101
	(0.045)	(0.117)	(0.024)	(0.059)	(0.044)	(0.248)
Non-KBK drought prone X Age	0.085*	-0.018	0.044*	0.015	-0.081*	-0.062
	(0.046)	(0.102)	(0.024)	(0.073)	(0.045)	(0.183)
KBK	-2.833	-6.539**	-2.217**	-1.869	-0.127	-7.354
	(1.788)	(3.208)	(0.936)	(2.129)	(1.763)	(11.368)
Non-KBK drought prone	-3.459*	0.209	-2.128**	-2.722	3.357*	2.291
	(1.798)	(3.896)	(0.909)	(2.922)	(1.808)	(8.031)
Current Age	-0.084**	0.080*	-0.037***	-0.030	-0.019	0.056
	(0.035)	(0.046)	(0.014)	(0.033)	(0.023)	(0.097)
Intercept	153.995***	147.690***	152.407***	152.293***	151.798***	148.222***
	(1.375)	(1.750)	(0.546)	(1.352)	(0.909)	(4.339)
Observations	4183	418	10366	1093	3975	282
R sq.	0.003	0.052	0.002	0.038	0.002	0.036
Data Source used:	NFHS4	IHDS2	NFHS4	IHDS2	NFHS4	IHDS2
Sample women:	Underweight	Underweight	Normal weight	Normal weight	Overweight	Overweight

Note: For analysis we however consider only three weight ranges - underweight category includes women with BMI less than 18.5 kg/m^2, normal weight includes women with BMI greater or equal to 18.5 kg/m^2 but less than 25.0 kg/m^2, and overweight women to include ones with BMI greater than or equal to 25.0 kg/m^2. Jacknifed Standard errors in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$

Table A7: Extended Difference-in-Differences regression results for baseline Above-Poverty-Line and Below-Poverty-Line women – Robustness Checks

	(4) BMI	(5) BMI	(6) BMI	(7) BMI
KBK X Post	0.732	1.790***	-2.362*	1.642**
	(0.559)	(0.635)	(1.412)	(0.814)
Non-KBK Drought-prone X Post	-0.568	0.489	-3.666	0.741
	(0.827)	(1.004)	(3.726)	(0.653)
Intercept	21.497***	25.964***	16.634**	10.583**
	(5.259)	(7.711)	(6.316)	(4.529)
Observations	487	313	394	848
R sq.	0.393	0.476	0.380	0.304
Household Controls	Y	Y	Y	Y
Individual Controls	Y	Y	Y	Y
Month X Year Fixed Effects	Y	Y	Y	Y
District Fixed Effects	Y	Y	Y	Y
Ration Card Status	Baseline Above-Poverty-Line	Baseline Above-Poverty-Line	Baseline Above-Poverty-Line	Baseline Below-Poverty-Line
Sample Women	Excl. no card holders at endline	Excl. non Above-Poverty-Line at endline	Restricted	Restricted

Data Source: Panel IHDS-1 and IHDS-2 women's data. IHDS surveys include HHs sampled from 26 out of 30 districts in Odisha. In Cols 4 our sample excludes all women who were Above -Poverty-Line card holders at baseline but held no ration card at endline and in col 5 our sample excludes all baseline Above-Poverty-Line who did not retain their above poverty line card status at endline. In col 6 & 7, we are running regressions for only those districts where either all or none of the blocks hold drought prone status. Jacknifed standard errors in parentheses * p < .1, ** p < .05, *** p < .01

Table A8: Extended Difference-in-Differences regression results by baseline BMI categories – Robustness Check

	(4) BMI	(5) BMI	(6) BMI
KBK X Post	1.857***	-0.435	3.801
	(0.689)	(0.638)	(2.453)
Non-KBK Drought-prone X Post	-0.725	-0.620	-6.359**
	(0.841)	(1.078)	(2.567)
Intercept	17.030***	14.536***	3.437
	(3.315)	(3.707)	(29.506)
Observations	494	965	144
R sq.	0.338	0.321	0.409
Household Controls	Y	Y	Y
Individual Controls	Y	Y	Y
Month X Year Fixed Effects	Y	Y	Y
District Fixed Effects	Y	Y	Y
Women's BMI Category	Under weight	Normal weight	Over weight
Women's Sample:	Restricted	Restricted	Restricted

Data Source: Panel IHDS-1 and IHDS-2 women's data. IHDS surveys include HHs sampled from 26 out of 30 districts in Odisha. In Col 4, 5 and 6 we report regression results for women who at baseline were underweight (BMI < 18.5 kg/m^2), normal weight (BMI >= 18.5 kg/m^2 & BMI < 25 kg/m^2) and over weight (BMI >= 25.0 kg/m^2) respectively. Moreover, the analysis has been done only for a restricted group of districts – those that either have all or none of their blocks holding drought prone status. Jacknifed standard errors in parentheses * p < .1, ** p < .05, *** p < .01

Table A10: Difference-in-Differences regression results for consumption of other PDS items (In kg/ litres, in last 30 days), by baseline ration card status

	(1) =1 if PDS wheat purchased	(2) Qty of PDS wheat purchased	(3) =1 if PDS sugar purchased	(4) Qty of PDS sugar purchased	(5) =1 if PDS kerosene purchased	(6) Qty of PDS kerosene purchased
Baseline Above-Poverty-Line						
KBK X Post	0.119	0.467	0.047	0.032	-0.113	-1.063*
	(0.232)	(1.868)	(0.125)	(0.215)	(0.123)	(0.546)
Non-KBK Drought-prone X Post	0.091	0.627	0.198*	0.364	0.136	0.674
	(0.153)	(1.432)	(0.119)	(0.223)	(0.116)	(0.430)
Observations	648	648	648	648	648	648
R sq.	0.375	0.438	0.241	0.229	0.202	0.191
Baseline Below-Poverty-Line						
KBK X Post	0.041	0.175	0.161*	0.399**	0.014	-0.831***
	(0.038)	(0.285)	(0.088)	(0.163)	(0.056)	(0.211)
Non-KBK Drought-prone X Post	0.007	0.032	0.278***	0.240	-0.025	-0.279
	(0.039)	(0.323)	(0.091)	(0.164)	(0.050)	(0.250)
Observations	1341	1341	1341	1341	1341	1341
R sq.	0.135	0.144	0.397	0.304	0.132	0.162
Household Controls	Y	Y	Y	Y	Y	Y
Individual Controls	Y	Y	Y	Y	Y	Y
Month X Year Fixed Effects	Y	Y	Y	Y	Y	Y
District Fixed Effects	Y	Y	Y	Y	Y	Y

Data Source: Panel IHDS-1 and IHDS-2 women's data. Jacknifed standard errors in parentheses * p < .1, ** p < .05, *** p < .01

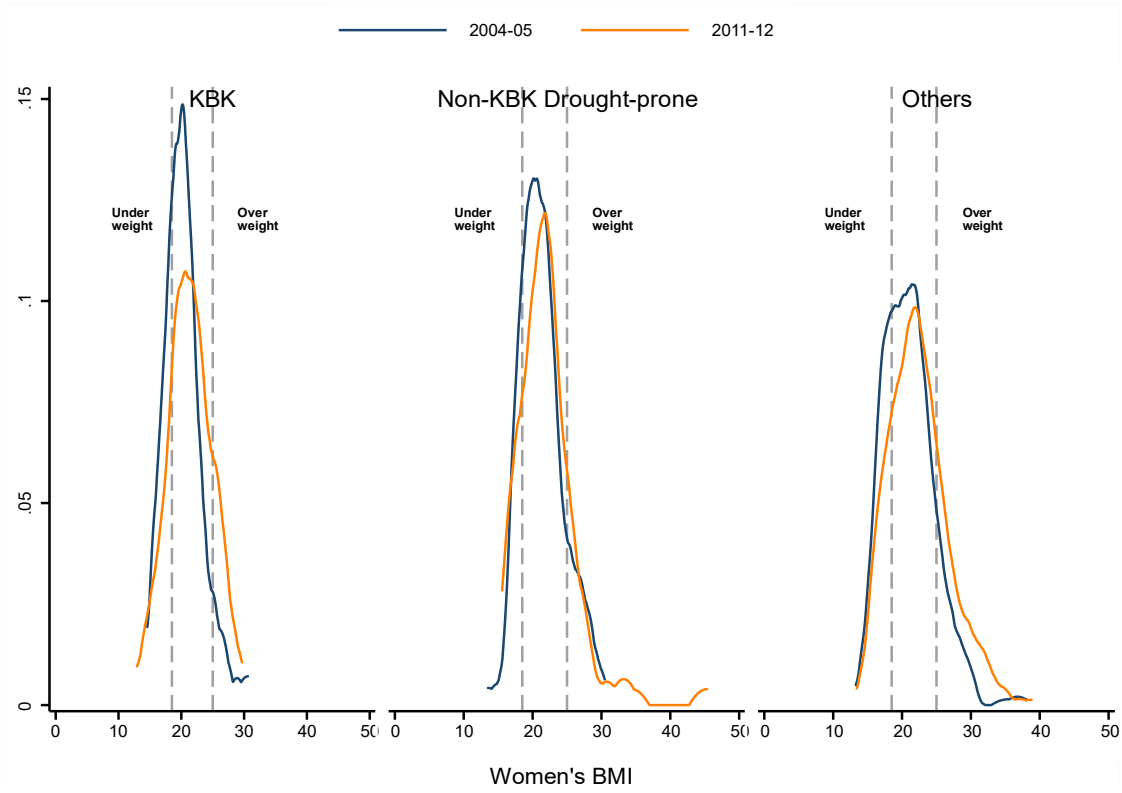
Table A11: Difference-in-Differences regression results for consumption of and expenditure on various food items (In last 30 days), by baseline ration card status

	Baseline Above-Poverty-Line		Baseline Below-Poverty-Line	
	(1) KBK X Post	(2) Non-KBK Drought-prone X Post	(3) KBK X Post	(4) Non-KBK Drought-prone X Post
Wheat (kgs)	-1.282	-1.608	-3.246	-0.646
	(3.647)	(1.908)	(2.396)	(0.897)
Sugar (kgs)	1.776**	-0.627	0.341	0.643
	(0.754)	(0.845)	(0.533)	(0.544)
Kerosene (litres)	0.560	-0.369	-0.666**	-0.105
	(0.481)	(0.484)	(0.299)	(0.281)
Other Cereals (kgs)	0.667	0.039	-2.842*	0.660
	(0.473)	(0.602)	(1.660)	(0.699)
Pulses (kgs)	0.260	-0.551	-0.702	0.543
	(1.659)	(1.446)	(0.939)	(0.486)
Meat/Chicken/Fish (kgs)	-1.603*	-1.547**	-1.367**	-0.131
	(0.847)	(0.633)	(0.566)	(0.341)
Gur/Sweetners (kgs)	-1.023	-0.225	-0.521***	-0.344
	(1.072)	(0.389)	(0.172)	(0.283)
Edible Oil (litres)	-0.038	-0.568	-1.287*	-0.303
	(0.935)	(0.481)	(0.708)	(0.386)
Eggs (dozens)	-4.483	-1.460	-1.279	0.681
	(4.036)	(2.591)	(1.967)	(1.980)
Milk (litres)	-10.456**	-3.045	-5.576***	-1.681
	(4.362)	(2.955)	(1.401)	(1.118)
Processed Foods	-45.560	-65.438**	-39.761**	-50.930**
	(41.521)	(28.605)	(18.451)	(22.773)
Fruits and Nuts	-32.622	-18.347	-22.138**	-16.024**
	(29.945)	(16.475)	(8.983)	(7.113)
Milk Products	-62.776**	-22.549	-34.629***	-33.178**
	(26.834)	(20.040)	(11.629)	(13.345)
Cereal Products	-23.858	-75.034	-0.035	-35.123
	(37.511)	(50.379)	(20.904)	(21.381)
Vegetables	-136.674	-118.989	-46.556	-86.609
	(182.075)	(169.069)	(55.285)	(62.004)
Household Controls	Y	Y	Y	Y
Individual Controls	Y	Y	Y	Y
Month X Year Fixed Effects	Y	Y	Y	Y
District Fixed Effects	Y	Y	Y	Y

1. Source: Panel IHDS-1 and IHDS-2 women's data. 2. IHDS surveys include HHs sampled from 26 out of 30 districts in Odisha.

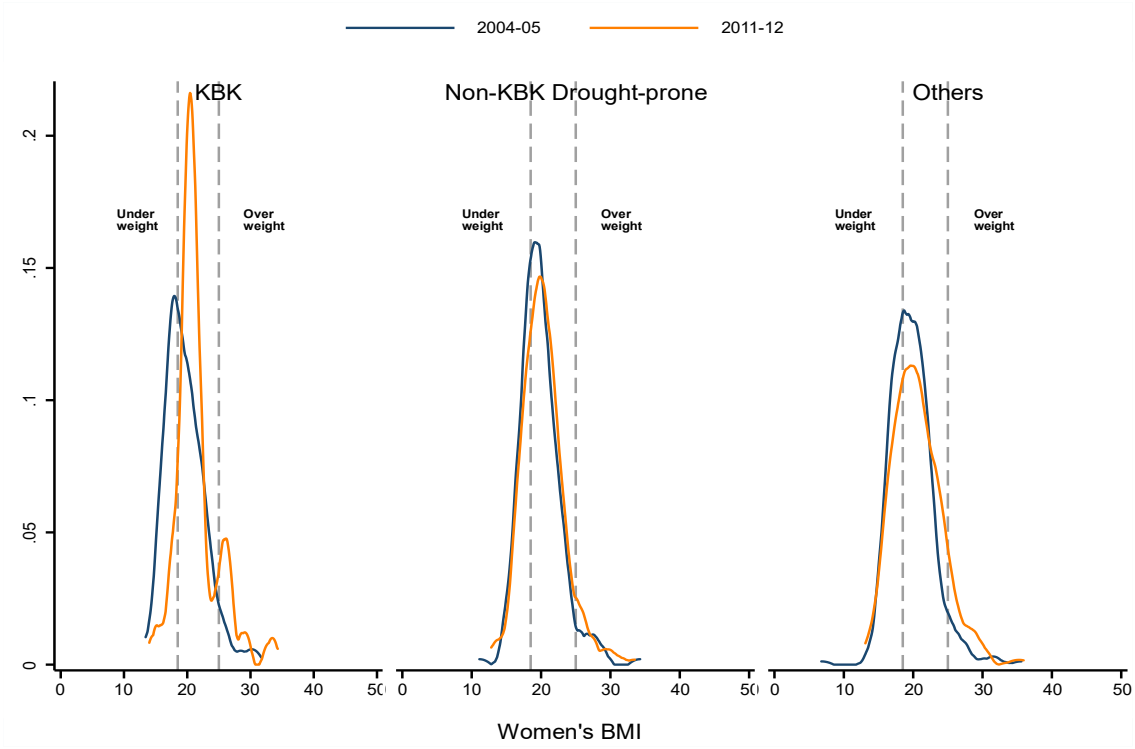
Jacknifed standard errors in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$

Figure A4: Kernel density of BMI of baseline Above-Poverty-Line women by survey round and region



Note: The dashed grey lines mark the cuttoff points (18.5 kg/m^2 and 25.0 kg/m^2) used to classify women in three weight ranges. Underweight category includes women with BMI less than 18.5 kg/m^2, normal weight includes women with BMI greater or equal to 18.5 kg/m^2 but less than 25.0 kg/m^2, and overweight includes women with BMI greater than or equal to 25.0 kg/m^2

Figure A5: Kernel density of BMI of baseline Below-Poverty-Line women by survey round and region



Note: The dashed grey lines mark the cuttoff points (18.5 kg/m^2 and 25.0 kg/m^2) used to classify women in three weight ranges. Underweight category includes women with BMI less than 18.5 kg/m^2, normal weight includes women with BMI greater or equal to 18.5 kg/m^2 but less than 25.0 kg/m^2, and overweight includes women with BMI greater than or equal to 25.0 kg/m^2