Title page

- Title of the proposed research: A home-production based approach to improve nutritional outcomes of children in rural areas.
- Targeted country (countries): India
- Host policy research institution(s): Indian Institute of Technology Kanpur.
- Authors: Debayan Pakrashi, Sounak Thakur and Chitwan Lalji

Abstract

Using detailed data from two nationally representative secondary and a primary dataset, we will investigate if home-production of food crops can help improve the nutritional status of children and their mothers. We also intend to assess if these households can better absorb the adverse effects of a shock. We will establish causality by complementing the results from the secondary datasets with a well-designed Randomized Control Trial (currently ongoing and fully funded) that will encourage women in treated households to raise a kitchen garden in their backyards. If the intervention is found to be effective in improving nutritional outcomes, the proposed idea could offer a scalable and cost-effective tool to the policymakers to combat malnutrition and mitigate shocks in other resource poor setting.

1. Introduction

Severe malnutrition, especially amongst children, has persisted in India despite rapid economic growth in recent decades. For instance, amongst children under 5 years of age, 38% were stunted and 36% were wasted (NFHS-4, 2015-16). Further, 53% of adult women were found to be anaemic. The severity of malnutrition in India has evoked comparison with much poorer countries of sub-Saharan Africa, and Indian girls, particularly those at higher birth orders have been found to have worse nutritional outcomes as compared to their counterparts living in much poorer sub-Saharan African countries (Jayachandran and Pande 2017). Nutritional outcomes in developing countries are also found to be sensitive to income shocks (Rose 1999).

In this project, we investigate a possible strategy that rural households in India may use to mitigate the impact of an exogenous shock on their nutritional outcomes. In particluar, we will study if home-production of food crops may serve as a possible mitigation strategy. We think that home-production improves the household's endowment of nutritious food items in most states of the world. For example, in the event of a sudden rise in the price of foodgrains, the owner-cultivator already has access to home-produced food. The non-cultivating household, however, needs to procure foodgrains from the market, and may witness a sharp decline in purchasing power in the event of a price shock, given credit market imperfections in rural India.

Our empirical strategy will be two-pronged. First, we will use data from two large nationally representative datasets, namely, the two-waves of the India Human Development Survey (IHDS) (2004-05 and 2011-12) and the 68th round of the National Sample Survey (NSS) (2011-12) to test the hypothesis whether home-production of food crops are associated with better nutritional status. We will use detailed data from a recent RCT to investigate if the associations estimated with the secondary data are indeed causal in nature. The experimental intervention in this RCT will provide women with resources, training, and encouragement to raise a small kitchen garden in their backyard. Secondly, we will investigate if small home-producers are able to mitigate the effect of exogenous shocks better than their counterparts, who do not self-cultivate any food crops.

We believe that the findings of our study will be important for quite a few reasons. First, if we find that small home-producers can better insure their food consumption than their counterparts, the government may encourage poor households to raise a kitchen garden to

help them insure against any fluctuations in real incomes. This will provide the policymakers with a scalable and cost-effective tool to enable households to smooth food consumption in the event of macroeconomic shocks like inflation, demonetization, and recessionary spells such as the one induced by the ongoing pandemic. Second, our study will present a comprehensive picture of how intrahousehold allocation responds to income shocks.[1] Finally, the RCT will shed light on whether empowering the woman in the household to control the production of nutrient-rich food items can improve the nutritional outcomes of women and children.

2. Related Literature and Contribution

The problem of a high incidence of malnutrition has long been recognized in the Indian context (Svedberg, 2000). As the Indian economy grew through the 1990s, the incidence of malnutrition declined somewhat unevenly between urban and rural areas (Tarozzi & Mahajan 2007). Nonetheless, the problem persisted, particularly amongst girls at higher birth orders, who, curiously enough, had worse nutritional outcomes as compared to their counterparts living in much poorer nations of sub-Saharan Africa (Jayachandran & Pande 2017).

Over the years, public policy has responded variously to the challenge. For instance, the government's public distribution system (PDS) has attempted to distribute food grains at low prices to very poor families. The government has also implemented measures like Integrated Child Development Scheme (ICDS) and a mandated school meal program (midday meal program) with a view towards improving the nutritional outcomes of children. A careful evaluation (Afridi 2011) finds that the midday meal program improved children's nutrtional outcomes by a substantial margin. However, both the ICDS and the midday meal scheme were suspended in the wake of school (and anganwadi) closures during the pandemic.

Recent studies have evaluated the impact of microcredit programme participation on food security (Islam, et. al., 2016; Imai & Azam 2012). There are several pathways, through which access to credit may improve food security: First, accessing credit may generate 'investment-led' benefits, second is via 'insurance-led' benefits by assisting households to diversify into more profitable self-employment-based activities (Gertler et. al. 2009; Islam & Kochar 1995; Khandker et al., 2012). Finally, microcredit may also improve nutritional security indirectly via nutritional knowledge (e.g., Bakshi et al., 2015; Heikkilä et al., 2016). Moreover, women were found to play a vital role in sustaining the nutritional status of their families (Kurz and Johnson-Welch, 2001).

However, there remain several challenges in deploying traditional policy tools in the form of different welfare schemes in response to income shocks (for example, the recent economic contraction in the wake of the pandemic) in developing country contexts. Governments in developing countries are much more fiscally constrained than their counterparts in the developed world. Moreover, rural populations are often not aware of the programs being implemented by the governments, their entitlements and how to access them and it appears that food insecurity has emerged as a major problem in the developing world (Malik et. al.,

[1] While the existing literature suggests women's outcomes to be more volatile in response to shocks, our analysis will provide a comprehensive picture of how the income shock is shared amongst different members in the household. For instance, our analysis will shed light on the following questions: Do the health outcomes of adult women fluctuate more than the outcomes of adult men? How vulnerable are young children? Do girls at higher birth orders fare worse than girls at lower birth orders? Do households better insure pregnant and lactating mothers as compared to other women?

2020; Ahmed et. al. 2020). Under these circumstances, the ideal policy response should guarantee food security to the vulnerable section of the population in a cost effective manner. We believe that our proposal of raising a kitchen-garden within the household will provide an effective tool to the policymaker that will boost nutritional outcomes via nutrition-focussed intervention programmes.

3. The Data

The current project will use data from the IHDS (panel structure), the NSS (68th round), and data from the RCT that we are currently conducting in the state of Uttar Pradesh in India. The primary data will fill the gap in the existing secondary datasets and help establish causality. We describe each of the two secondary data sources in detail below. Details of the RCT are presented in the next section.

A. Data from Secondary Sources

The IHDS data contains detailed information on the cultivation of crops by owner-cultivators. To be more specific, IHDS-1 contains information on the quantity of agricultural land held by the household, in which cropping season(s) it was cultivated in the past year, and what crops were grown. It proceeds to ask what fraction, if any, of the crop went to the landlord, and what fraction was sold. From these questions, we will be able to back-calculate the amount of the crop consumed by the farm household, dietary diverty, total calories and nutrients consumed. Further, with these pieces of information, we will be able to identify which households operate plots of land, and restrict our analysis to these landowners. Further, the IHDS dataset provides height and weight measurements of children under 11 years of age and of the eligible woman in the household.

The 68th round of the NSS contains information on quantity of cultivated land owned and the type of land owned (homestead and other land; and other land only). From here we can identify the households who have a homestead (and also the households with small cultivated land area). Besides, the NSS provides substantially richer data on household consumption. It provides information on the amounts consumed of each of the following common food items: cereals, pulses, milk and milk products, sugar, salt, edible oil, egg, fish and meat, vegetables, fruits, spices, beverages and processed food and pan, tobacco and intoxicants. This information will enable us to compute the nutritional/calorie intake in the form of energy, protein and fat for each household or per person in the household (by applying conversion factors using the Gopalan et al. (1981) nutrition chart); along with percentage of calories from different food groups and average number of meals consumed per person/household.

Both the IHDS and NSS datasets contain geographical identifiers at the district level. We will merge this geographical information with the temperature and precipitation data obained from the University of Delaware dataset. We will define rainfall shock as rainfall one or more standard deviations below historical average for the district. The three collaborators on the project have access to both the IHDS and NSS datasets. All the three collaborators have experience working on the IHDS dataset, and Dr. Pakrashi has experience working with the NSS dataset.

B. The Randomized Controlled Trial: Experimental Design and Program Description

The proposed intervention consists of nudging rural households in Uttar Pradesh to raise a kitchen garden in their backyards as a source of micro and macro-nutrients. The proposed study spanning about 6 months will be conducted as a *RCT* that will include 1,800 households from 90 villages in the district of Kanpur (power calculations provided in the Appendix). Villages will be randomly assigned to one of the two treatment arms or the control. An eligible woman from each treated household will be the recipient of all training and cash transfers, if any. The eligibility criteria that we will use will be: (1) married women aged 15-49; (2) with at least one child aged 0-10 years; (3) willing to participate in the proposed program; and (4) has a small plot of land for kitchen garden in the premises of the house.

The first treatment arm (30 villages, 20 households from each village) will be provided *cost-free access* to the following intervention:

(i) Information on the nutritional value of different vegetables and fruits that we will suggest that households cultivate.
(ii) Training about how to raise a nutri-garden that will include advice on the optimal use of fertilizers, pesticides, and zero-budget farming practices to be used in cultivation

The second treatment arm (30 villages, 20 households from each village) will receive both the free provision of awareness and knowhow and a conditional cash transfer. Thus, all households in the second treatment arm will receive the following treatments:

(i) The treatment detailed above for Treatment Arm 1
(ii) A reimbursement of input costs (up to 200 Indian rupees i.e., about USD3) to households that end up cultivating and maintaining a kitchen garden.

Households assigned to the control (30 villages, 20 households from each village) will not receive any intervention.

The baseline survey will elicit detailed information on household composition and socio-economic characteristics. The baseline and endline survey shall have modules on consumption, anthropometry, and morbidities.

The intervention is expected to have a direct impact first on awareness and knowledge related to the benefits from having a kitchen garden, the nutritional value of different vegetables and fruits as well as on adoption i.e., whether households try and maintain a kitchen garden on their premises. It is only via adoption that we expect kitchen garden to eventually impact a range of different outcomes such as income and savings, health, and nutrition of mothers as well as children, captured via incidence of malnutrition, food and nutrition security, dietary diversity, calories, and micro- and macro-nutrients consumed, likelihood of falling ill frequently, subjective physical and mental health, cognitive and non-cognitive skills. Further details regarding proposed variables and the sampling procedure are presented in the Appendix.

C. Funding for the RCT

The RCT has already been fully funded by the Indian Institute of Technology Kanpur (IIT-K) by way of an Initiation Grant to Dr. Thakur. It is currently an ongoing project. The Initiation Grant is provided to all faculty members who join IIT-K.

4. The Empirical Strategy

At first, we will use the following regression specification:

$$Y_{iv} = \beta_0 + \beta_1 T_i + \gamma X_{iv} + \sigma_{iv} \qquad (1.1)$$

to estimate the association (using the secondary datasets) and causal impact (using the RCT) of home-production of food crops on nutritional outcomes, where Y_{iv} is the outcome variable while T_i is the treatment indicator. X_{iv} is a set of observable household and children characteristics, such as age and gender of the respondent (or child), religion and caste of the household, marital status, education and employment status of the respondent, and finally household size and composition. We will cluster the standard errors at the village level. We will estimate both ITT and LATE. We will also try to understand the differential impact (if any) by gender, by socio-economic status, caste, and religion.

In addition, we will estimate another equation:

$$Y_{ivd} = \alpha_0 + \pi_1 I_d + \pi_2 (I_d \, X \, T_{ivd}) + \pi_3 X_{ivd} + \epsilon_{ivd} \quad (1.2)$$

where**,** Y_{ivd} refers to the outcome of household *i* residing in village v (from district *d*). I_d is an indicator for district d having been subjected to an exogenous shock in the year of survey, and X denotes a vector of controls such as background characteristics of the household. We are interested in outcomes such as household food consumption and health outcomes (height-for-age, weight-for-height and weight-for-age for children) and BMI for adult women. Since we hypothesize that owner-cultivators are better able to insure food consumption, we expect π_2 to be positive and significant.

5. Proposed division of labor among team members

All three collaborators will be responsible for carrying out the analysis on the NSS and IHDS datasets. Dr. Pakrashi will take the lead in implementing the RCT and will be assisted by Drs. Lalji and Thakur in the task.

6. Proposed Timeline

We plan to clean and analyse the secondary datasets between October 2021-February 2022. Alongside, we plan to get the ethical clearance for the RCT from IIT-K in August 2021 and conduct the baseline survey in September 2021, the intervention in October-November 2021 and the endline survey in February 2022. Between February-May 2022, we plan to analyse the data from the RCT and prepare the first draft of the paper. Comments received during the US-visit shall be incorporated in August-December 2022, thereby preparing the final draft.

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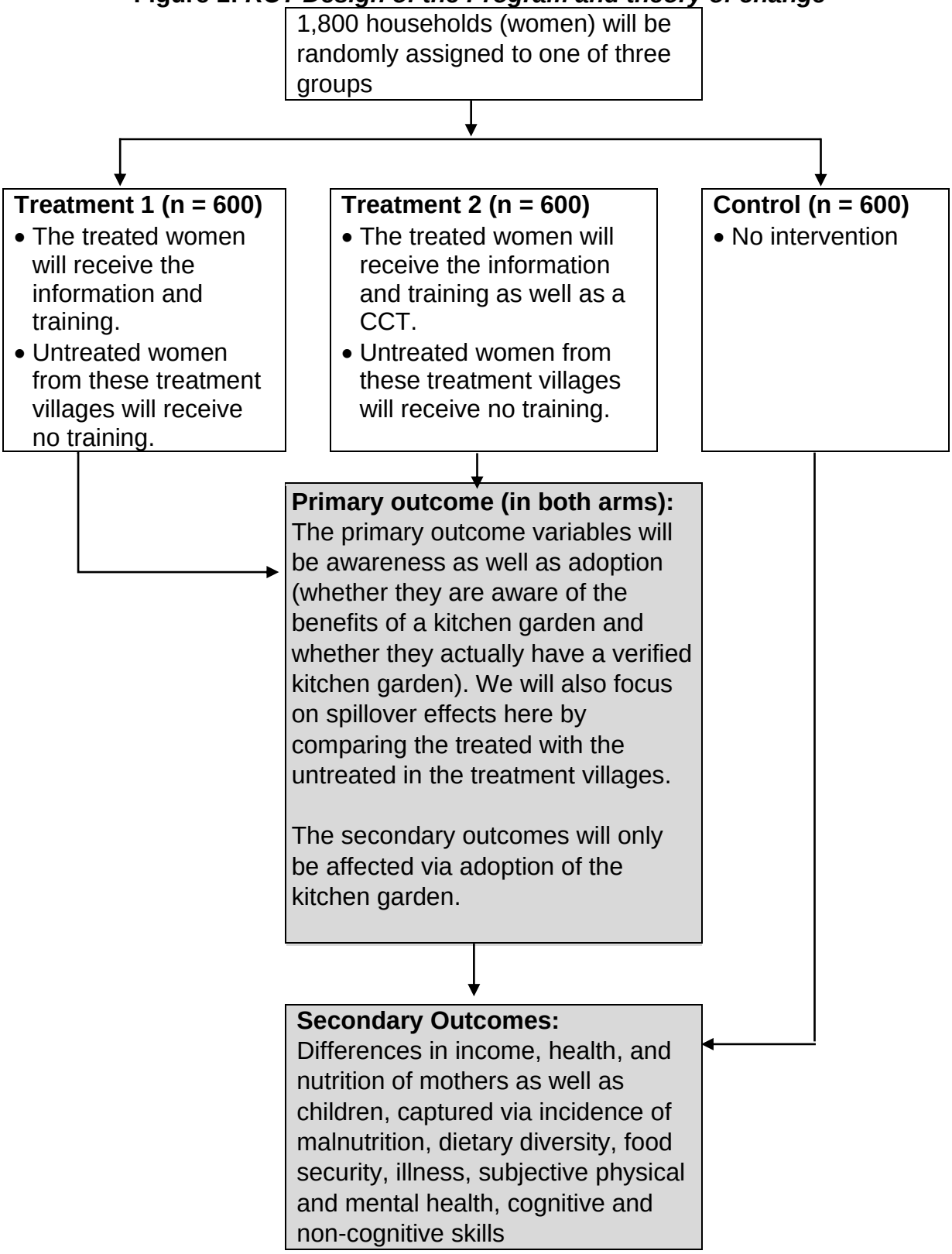
Technical Appendix

The RCT design

Figure 1: *RCT Design of the Program and theory of change*



Source: Authors' design.

Sample Size and Power Calculations (optional)

Proportion that adopts = 0.25 (hypothesized adoption rate of the kitchen garden)
Standard error of the estimated proportion = 0.433 (maximum possible value)
Alpha = 0.05 (standard type I error)
n = 20 (average cluster size)
power = 0.80 (standard)
ICC = 0.20 (conservative estimate)
With these parameters, you need 25 villages per treatment arm to have 80% power. To be on the safe side, we will use 30 villages per treatment and 20 households per village. So, the total sample size for our proposed project is 1,800.

Sampling Procedure

To select the households that we will be focusing on in the proposed project we will adopt a three-stage randomization approach. Using the detailed maps and the list of villages in the district of Kanpur, we will first randomly select the 90 villages via stratified random sampling from a list of about 200 villages. A stratified random sampling procedure will be very carefully designed to ensure that the households covered in the program constitute a representative sample of all households in rural Uttar Pradesh. We will then prepare a list of about 40 eligible women from each of these villages. In the second phase, 20 women will be randomly selected from this list of 40 eligible women from each village.

Randomization into treatment and control groups will be done next at the village level. The 1,800 eligible households identified from the 90 villages will then be randomised at the village level (using a computer), with about 30 villages (and 600 households) in each of the two treatments or control arm. Finally, from each of the treatment villages we will randomly select about 40-80% treated women (A) to receive the treatment (treated within the treatment villages) and the rest will not receive any treatment and will constitute the untreated (B) within the treated villages, such that A+B=20. This three-stage randomization will not only allow us to estimate the treatment effects (comparing treatment to control women) but will also give us an idea about spillover effects from the treated to the untreated in the treatment villages, and also based on the intensity of treatment (fraction trained) in each village.

Details of Variables to be Collected in the baseline and endline survey for the RCT

The baseline survey will include separate modules designed to collect detailed information on different aspects of the household members. 1. Household Roster: collect personal and other socio-demographic characteristics (household composition and age, gender, occupation and education status of the household members); 2. Economic characteristics: household income, assets and expenditure, savings, primary and secondary occupation, etc; 3. Anthropometry: Height, weight and mid-arm circumference of all household members; 4. Morbidity and Health seeking behaviour: health, hygiene and cleanliness behaviour, include immunization, illnesses; 5. questions related to stress and depression (such as GHQ-12 and Perceived Stress scale) as well as self-assessed health and happiness; 6. Module to capture the food security situation of the household (based on the Household Consumption Expenditure Survey, the 12-scale Household Dietary Diversity Score (HDDS) developed by FANTA and the Food

Insecurity Experience Scale); 7. The questionnaire will also include questions to assess the ability to remember the knowledge disseminated to the women during the training sessions; 8. Social network information such as detailed data on social links (e.g., kinship, neighbor, chatting) with other households in the selected sample will also be collected, to understand how spillover may be affected by how closely the treated are related to the untreated. The endline survey will repeat the modules on anthropometry, health and morbidity, food and nutrition security and health and wellbeing.

Potential Ethical Risks

The proposed study does not involve any major risk in terms of implementation. IRB (Ethical clearance) will be obtained from both IIT Kanpur. The protection of human subjects involved in this project will be ensured by following the instructions laid down by the Ethics Committee at IITK. The Ethics Committee (EC) specializes in such ethical issues in research involving humans conducted by university communities and will therefore protect the rights and welfare of the individuals targeted in this project. No physical action is required in this project and the experiment will only improve the conditions of those residing in the project locations by encouraging and motivating them to adopt kitchen garden, which will only improve health and wellbeing. The safety of everyone involved in the experiment is assured and of utmost importance.

As per the rules of the ethics committee, it will be explained to the targeted beneficiaries that their participation in this research project will be voluntary, and they could withdraw from the research at any stage. All the information provided in the interview will remain strictly confidential, except as required by law and persons interviewed will remain anonymous to all but the research team. For all practical purposes, participants will be randomly assigned a subject ID number at the start of the experiment, and this will be used when analysing the data. Participants' names and addresses will not be used during the data analysis; they will only be used to track them down during the following surveys. Subjects are also informed about their privacy and confidentiality rights before the commencement of the experiment, and this will be displayed in the consent form that they will sign. After finishing the survey and computerisation of data, all the questionnaires will be preserved safely. All data will always be stored on the project computer that will be password enabled.

Attrition Analysis

There may be some attrition between the baseline and the endline surveys. Based on our past experience with similar RCTs, we expect attrition to be limited (1 to 2%) in the current project. Nonetheless, we should be prepared to deal with attrition, should it occur. Typically, attrition occurs when a household drops out while the intervention is underway or refuses to participate in the endline survey. If we do have attrition, we will compare the characteristics of the attritors with those of the non-attritors at the baseline. If these do not differ much, we will conclude that the attrition is not selective.

Further, we plan to carry out two robustness checks. First, we will re-estimate the main treatment effects using inverse probability weighting (IPW), whereby households with characteristics similar to attritor households will be given higher weights. Second, we will

use a non-parametric attrition bounds approach (Lee (2009)) that entails first sorting outcomes from best to worst within treatment and control arms. Subsequently, we will trim `additional' samples from above and below in the treatment group. This will yield lower and upper bound estimates of the main treatment effect.

Social desirability bias

It is well-recognized that self-reported outcomes are susceptible to a social desirability bias. The concern here is that the respondent may be providing answers that she thinks the interviewer wants to hear, and not what she actually thinks/feels/does. To address this concern, we will use a 13-item Marlowe-Crowne social desirability scale, which is a module designed by social psychologists to measure the tendency of the respondent to provide socially desirable responses. We will administer this survey at the baseline. We think that if assignment to treatment is at random, and if the randomization is done properly, the treatment and the control groups will be balanced in terms of the social desirability bias. We will also have objective outcomes in addition to self-reported outcomes.

Multiple Hypotheses Testing

Given that we will be testing multiple hypotheses, we will use p-values adjusted using the Westfall-Young (WY) adjustments (Westfall & Young, 1993), which uses a bootstrap resampling procedure to account for correlations across outcomes.

Randomization Inference Test

Randomization-based inference will be used for the p-values reported. These are constructed by randomly "assigning" the treatment dummy and re-estimating our coefficient of interest using the placebo assignment about 1000 times. Based on this exercise we will test the null hypothesis that the placebo coefficients are similar to the actual coefficients, and report p-values obtained from the two-sided RI test.