Menstrual Health Sensitisation, Sanitary Products and Scholastic Performance: Evidence from Impact Evaluation in Delhi–NCR (Pre-Analysis Plan)*

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Abstract

This document describes the analysis plan to evaluate the impact of two interventions, distribution of Sanitary Products and Menstrual Health Sensitisation in the form of lectures on the overall scholastic performance of girls in school. This was done in collaboration with CSR Research Foundation which installs Sanitary Napkin Vending Machines on a charitable basis. Three schools were chosen randomly on the basis of a list provided by them and the machines were installed in October 2019 in two. Further, bi-weekly sessions were conducted in one school on Menstrual Health. The present document outlines the outcome variables and econometric methods we will use to assess the effect of the program on Marks, Attendance, Self-confidence, and Extra Curricular Activities Participation as well as Sensitivity Index for boys.

1 Introduction

There has been an increasing priority among public policy experts towards female education in developing countries. Girls lag behind boys in schooling attainment, and female schooling is thought to be important for a variety of development outcomes (Barbara L. Wolfe and Jere R. Behrman 1987 [3]; Behrman and Wolfe 1989[4]; Paul Glewwe 1999[6]; Behrman and Mark R. Rosenzweig 2002[1][2]).Policy-makers have argued the importance of menstruation in limiting school attendance and attainment (Yewoubdar Beyene 1989[5]; Barbara Herz et al. 1991[7][8]; Golnar Mehrah 1995[12]; Annemarieke Mooijman et al. 2005[15]; Marni Sommer 2010[14]). Considering that there are additional returns to investing in girls education on future generations [13] it is imperative to ensure increased participation of females in education. It has been pointed out that one of the most effective ways to ensure higher attendance among girls would be by making sanitation facilities available to them (Kristof 2009[11]). Jewitt and Ryley[9] have also pointed out the increased gap that has been created by the decline of traditional teaching on menstruation and sex in a community setting that is not currently being tackled effectively either at home or in school that

*This pre-analysis plan was drafted some time between the start and end of the program. Hence data analysis had actually not started then.

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make it more difficult for girls to understand the sexual risks/diseases that are more likely to affect them than boys.

We, therefore, propose to study the impact of these interventions of providing access to sanitary products, sanitary napkins in this case, and that of sensitization. The three schools in the study invite students from the lower strata of Delhi NCR specifically owing to the fact that poverty plays a big role in the withdrawal of girls from schools (Jewitt and Ryley et al. 2014[9]). Considering the fact that sensitization will have an impact on multiple aspects of performance we study the impact on four distinct dimensions. First, we use participation in classrooms measured by attendance in schools. Second, participation in Extra-Curricular activities by the number of hours spent on an average to a particular activity of interest as it pertains to overall growth and development of an individual. Third, self-confidence measured through Rosenberg self-esteem scale as this increases their levels of classroom engagement. Lastly, we study the impact on academics through marks scored in an academic year. We also make note of the sensitivity index for boys of the same age group. There is further scope to analyse the impact of this sensitivity on the variables for girls but they are beyond the scope of this paper.

Through this study we aim to make a case for the introduction of proper sex education as a part of a larger health curriculum along with the distribution of sanitary products.

2 Treatment

The intervention is introduced in the schools of Delhi NCR that have students from the lower income strata of the society (annual income less than one lac twenty thousand rupees). Three schools were selected after randomising a list of schools given by the NGO CSR Research Foundation and sanitary napkin vending machines were installed in two treatment group schools by CSR Research Foundation on 7th October, 2019. Sanitary napkins, thereon, were distributed free of cost to the female students as and when required. After deciding an appropriate sample size, 50 girls and 50 boys were randomly selected from classes 8-12 to study the impact. Sensitization was held bi-weekly, post the installation of the machine, as a collaborative effort of the researchers and the science teachers of the intervention school-2 to impart a curriculum on menstrual hygiene and good health practices. The curriculum was imparted separately to boys and girls in the form of a one-hour lecture/discussion. The curriculum is based on Booklet 9 of UNESCO's Good Policy And Practice In Health Education on Puberty Education & Menstrual Hygiene Management[10].

3 Evaluation Questions

Our main questions are:

(i) **What is the overall impact of distribution of sanitary products on the welfare of school-going girls?** This is to infer how vending machines for sanitary napkins fare as a public investment for female participation.

(ii) **What is the impact of sensitization on the welfare of girls?**

Welfare, here, is a form of success in classroom measured through four variables of marks, attendance, ECA and self-esteem of girls. We are also studying the impact of sensitization on the sensitivity index for boys.

4 Research Hypotheses

We hypothesize that upon our intervention:

1. schoolboys in the treatment group will become more sensitive towards menstrual health than the comparison group;

2. schoolgirls in the treatment group will have a higher self-esteem than the comparison groups; and

3. schoolgirls in the treatment group will record higher attendance, marks, and ECA participation than the comparison groups.

5 Evaluation Design

5.1 Sample

We first went ahead with setting a minimum detectable effect (M.D.E.) size to help us determine the sample size for our intended study. The MDE is the smallest effect that a given evaluation. It is given as:

$$\Delta\mu = \mu_{treatment} - \mu_{control} \tag{1}$$

Once we settled on our MDE sizes for different outcomes of interest, we then set out to decide on a sample size. We had to keep in mind budgetary and logistical constraints while choosing the sample size for our study. So, in accordance with that and the counsel given to us by our staff advisor and other faculty members, we decided the following sample size:

Group	**Size**
Control Group	50 girls
	50 boys
Treatment Group 1	50 girls
	50 boys
Treatment Group 2	50 girls
	50 boys

Table 1: Sample size for different groups in our study.

The demographic profile was chosen keeping in mind mainly two specific background characteristics- class and gender. We were provided with a list of schools in the National Capital Region by CSR Research Foundation, an NGO based in Delhi. We used this list to randomly select three co-education schools in Delhi NCR by performing list randomisation. The population in these schools on average has an income of less than INR 1,20,000 per annum per household. One of the schools initially selected for our study denied permission to conduct survey in the school. This is understandable given the sensitive information that the questionnaires are asking for. Hence, we had to perform another round of list randomisation to select three schools from the same list (minus the school which denied permission). The schools turned out to be distributed over Delhi and NCR. We then randomly assigned our treatment and control groups in these schools; the results of which are as follows-

Group	Location in Delhi-NCR
Control Group (CG)	Greater Noida
Treatment Group 1 (TG 1)	North-West Delhi
Treatment Group 2 (TG 2)	West Delhi

Table 2: Geographical locations of our comparison and treatment groups

5.2 Compliance & Attrition

5.3 Data Collection

The data was collected through monthly surveys in these three groups. The baseline and intervention survey was conducted on October 3rd 2019. The intervention commenced on October 7th 2019, and since then monthly surveys have been conducted uniformly across all groups. We initially planned to suspend our program in July 2020. However, owing to Covid-19 pandemic, we were unable to conduct the surveys for further months. Since there is little clarity on the improvement of this situation, we are resting on our wisdom to suspend data collection from February 2020. Further, we had to rule out telephone surveys to collect data because of the following reasons:

1. Incompatibility with the sensitisation process in the treatment groups. we couldn't run an effective sensitisation program through pre-recorded or live sensitisation chatter through a phone call. Moreover, since the schools in our study have also shut down, we cannot estimate the effects of our intervention in TG 1 and 2.

2. The questionnaires are lengthy and extend over an hour long collection of data. This is simply not effectively feasible for 300 students. The sample size is too large to efficiently conduct phone surveys.

The schoolgirls were broadly asked for information on the following in our monthly surveys:

1. Their menstrual cycle

2. What do they know about menstruation and menstrual health

3. Participation in Extra Curricular Activities (ECA)

4. Rosenberg Self-Esteem test

Additionally, other important variables like name, age, parental annual income, religion and caste were collected from both schoolgirls and schoolboys.

We use the Rosenberg's Self Esteem Score (RSES) to measure self-esteem in schoolgirls. Self-esteem is an individual's subjective assessment of their own worth, and quantifying it or choosing a quantifiable indicator for the same is a difficult task. We use the RSES as a uni-dimensional 10 point scale that measures an individual's self-worth by measuring both positive and negative feelings about the self. See Appendix A for more.

6 Expected Time Frame

We collected our baseline data on October 3rd 2019. The last round of data was collected in February 2020. We plan on starting with our empirical analysis in April 2020.

7 Empirical Analysis

What follows below traces the details of our empirical analysis. Primarily, we deploy a difference-in-differences approach to estimate the impact of our treatment.

7.1 Variables

The following variables were measured directly or indirectly from the collected data. (See next page)

Variable	Description
Age	Age of the student
Religion	Religion of the student
Fam_members	Number of family members in the student's household
Fem_members	Number of female family members in the student's household
Caste	Caste of the student
SI	Sensitivity Index for schoolboys. Range- [0,1] (see Appendix B).
Treat_boys	Treatment group dummy for boys
Class	Class of schoolboys
Attendance	Monthly attendance of schoolgirls in percentage
Control_schoolgirls	Treatment dummy for schoolgirls (TG 1=1, otherwise=0)
Treat_schoolgirls	Treatment dummy for schoolgirls (TG 2=1, otherwise=0)
Periods	Whether schoolgirls get periods or not
Regular	Whether periods are regular or not
Pain	Whether periods are painful or not
Degree_pain	Degree of pain during periods- little, moderate, extreme
Leave	Whether schoolgirls take leave because of periods
Marks	Aggregate of marks for each schoolgirl in every exam cycle. Exam cycles are quarterly, half-yearly, and annual/pre-board exams.
ECA_hours	Hours spent on ECA activities in last one month
Missing_ECA	Whether schoolgirls miss ECA/don't participate in ECA because of menstruation
ECA_participation	Whether schoolgirls participate in ECA or not.
RSES	Rosenberg self-esteem score for schoolgirls.

Table 3: Variables used in empirical analysis

7.2 Treatment Effects

Many impact evaluations settle with comparing differences across groups using the average treatment effects (ATE). The ATE estimate measures the difference in mean outcomes between treatment and control groups in an unbiased manner. The ATE is estimated with the following equation:

$$Y_i = \alpha + \beta T_i + \epsilon_i \tag{2}$$

Here Y_i is the outcome indicator for unit i, α is a constant which gives the mean of the outcome indicator for the control group, T_i is the treatment dummy, and ϵ_i is the error term. The most important variable of interest in this equation is the coefficient of the treatment dummy, β, which gives us the difference in means of the control and treatment group- the estimated impact of our program. Stata has a provision for estimating this difference in means using-

`teffects ra (outcomevariable) (treatmentvariable), ate`

A major drawback of ATE estimates is that it does not allow us to measure for control variables or covariates in our study which may have accounted for the difference-in-differences. This is where the intention to treat (ITT) comes in. The ITT estimate translates into what effect would the treatment program have on an average person given the covariates under consideration. The ITT is estimated using the following equation:

$$Y_i = \alpha + \beta T_i + \sum_{\substack{i=n \\ j=m \\ i,j=1}} \gamma_j X_i j + \epsilon_i \tag{3}$$

Where $\gamma_j X_i j$ represents the covariates X_j for each individual with their coefficients y_j.

7.2.1 ITT model for Schoolboys

In our attempt to estimate the impact of sensitising boys we take following variables as covariates-

- Class- The syllabus for Science in class 10, and Biology in class 12 includes menstrual health as a small part of its curriculum. This could significantly translate into knowing at least the science behind menstruation and affecting the sensitivity index.
- Number of female family members at home- Interactions with female counterparts at home might yield into a more sensitive attitude towards menstruation by understanding the discomfort better.

Hence, we estimate the following model to evaluate the impact of sensitising schoolboys for each month of collecting data separately:

$$SI_i = \alpha + \beta Treat\_boys_i + \gamma Class_i + \delta Fem\_members_i + \epsilon_i \tag{4}$$

where,

SI- sensitivity index for each schoolboy,
α- constant term,
$Treat\_boys$- treatment dummy (0 for CG, and 1 for TG),
$Fem\_members$- number of female members at home, and
$Class$- class dummy [0 for class 11 (all streams) and class 12 (non-biology streams); and 1 for class 10 and class 12 (biology stream)].

7.2.2 ITT Model for schoolgirls

We have four different outcome indicators measuring the impact of our programs for schoolgirls- attendance, marks, RSES, and ECA participation. We use the following four models to estimate the impact of our programs on each one of them.

6.3.2.1 Attendance

We identify the following covariates in estimating the impact of our program on attendance:

- Periods- Does the concerned individual get periods? Only those who do get periods might be inclined to take leave because of them.
- Regularity of periods- Does the individual under consideration get regular periods? 'Regular' is defined as once a month. Individuals who do not get regular periods may not take leave from school for the same.
- Pain- Do individuals experience pain during menstruation? Individuals who experience pain may tend to take more leave from school than the rest. This brings us to the next covariate.
- Degree of Pain- Out of those individuals who experience pain during their menstruation, the ones with higher sensitivity to the pain may take more leave than the others.
- Leave because of menstruation- Measures whether an individual takes leave from school because of menstruation.

Hence, our model to estimate the impact of our program on the attendance of schoolgirls every month of data collection is:

$$Attendance_i = \alpha + \beta Control\_schoolgirls_i + \beta Treat\_schoolgirls_i + \gamma Periods_i^* Regular_i + \delta Pain_i^* Degree\_pain_i + \zeta Leave_i + \epsilon_i \quad (5)$$

where,

Attendance- attendance of each schoolgirl in percentage for each month,
α- constant term effect of our programs on attendance,
Control_schoolgirls- treatment dummy (1 for TG 1, 0 otherwise)
Treat_schoolgirls- treatment dummy (1 for TG 2, 0 otherwise),
Periods- dummy for getting periods (0 for no periods, 1 for those who get periods),
Regular- dummy for getting regular periods (0 for irregular periods, 1 for regular periods),
Pain- dummy for indicating pain (0 for no pain, 1 for experiencing pain),
Degree_pain- degree of pain (0 for little and moderate pain, 1 for extreme pain), and
Leave- dummy for leave because of periods (0 for no, 1 for yes).

6.3.2.2 Marks

For marks, we use scores obtained from quarterly, half-yearly, and annual/pre-board exams which are converted into average percentage across all subjects by an individual. We include attendance as a covariate because students with higher attendance are likely to gain from attending classes and keeping up with the coursework. However, since attendance is an instrumental variable here, we can generate the interested attendance values from (5) and add them to our specification. We estimate the following model for three different exam cycles:

$$Marks_i = \alpha + \beta Treat\_schoolgirls_i + \gamma \widehat{Attendance}_i + \epsilon_i \quad (6)$$

where,

Marks- aggregate marks in percentage, as scored for the respective exam,
α- constant term effect of our programs on marks,

$Treat\_schoolgirls$- treatment dummy (0 for CG, 1 for TG 1, and 2 for TG 2), and

$\widehat{Attendance}$- predicted attendance from (5).

6.3.2.3 ECA

Monthly hours devoted to ECA- Data was collected on hours devoted per week on average in the last one month. We scale it up a multiple of four to get number of hours spent per month in ECA. We identify 3 covariates which might affect ECA participation apart from our intervention-

- ECA participation- Does the individual in concern take part in ECA activities? This outcome is only measurable for those who do.
- Not participating in ECA because of menstruation.

We estimate the following model:

$$ECA\_hours = \alpha + \beta Treat\_schoolgirls_i + \gamma ECA\_participation^* Missing\_ECA + \delta\epsilon_i \quad (7)$$

where,

ECA_hours- hours devoted to ECA in last one month,
α- constant term effect of our programs on ECA participation,
$Treat\_schoolgirls_i$- treatment dummy (0 for CG and TG 1, and 1 for TG 2),
$ECA\_participation$- participation dummy (0 for no ECA, 1 for any ECA), and
$Missing\_ECA$- dummy to measure if missed ECA or did not participate because of menstruation (0 for missing/not participating in ECA because of menstruation, and 1 for the rest).

6.3.2.4 RSES

We estimate the ITT effects of our model on RSES using the following model for each month:

$$RSES_i = \alpha + \beta Treat\_RSES_i + \epsilon_i \quad (8)$$

where,

$RSES$- as the name indicates, score on Rosenberg self-esteem test,
α- constant term effect of our programs on RSES, and
$Treat\_RSES$- treatment dummy (0 for CG and TG 1, and 1 for TG 2).

7.3 Attrition

We took immense efforts in our study to ensure that attrition rates were minimised. If attrition rates of greater than 10 % are found in our study (by the end of the program), then we'll adjust for that by taking Manski-Horowitz (MH) bounds. The upper MH bound is constructed by assigning the most positive outcome to all of those who drop out of the treatment group and assigning the most negative outcome to all of those who drop out of the control group. The lower MH bound is created using the opposite assumption. Using this approach we construct bounds for our estimates.

7.4 Bonferroni Adjustment

Glennerster & Takavarasha (2013) warn that for an evaluation with multiple outcome indicators, the probability of rejecting a true null hypothesis (Type I error) for at least one of the outcomes is greater than the significance level of each test. As a remedy, they suggest adjusting confidence intervals using the Bonferroni adjustment (since multiple hypotheses are being tested). In this approach, p-values are divided by the number of tests being undertaken to check for hypothesis. We deploy this method in our empirical analysis of ITT model for schoolgirls (section 6.3.2). Since we have 4 different hypotheses being tested at 5 % LOS, we have:

$$\text{adjusted } \alpha = \alpha/4 = 0.05/4 = 0.0125$$

Hence, we test each hypotheses for schoolgirls at the adjusted LOS of 0.0125. See Appendix C for more.

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Appendix A- Rosenberg Self-esteem Score (RSES)

The RSES is a uni-dimensional measure of an individual's self-worth. It was developed Dr. Morris Rosenberg in 1965. The psychometric properties of RSES make it more reliable and valid and thus the most widely used scale in social sciences. The questions are answered using a 4-point Likert scale format ranging from strongly agree to strongly disagree. There are 10 unique items on an RSES test/questionnaire. Items 2, 5, 6, 8, 9 are reverse scored. The points are given in the following format : "Strongly Disagree" 1 point, "Disagree" 2 points, "Agree" 3 points, and "Strongly Agree" 4 points. The Sum of scores of all the ten question is calculated. The scores are kept on a continuous scale. Higher scores indicate higher self-esteem.

		Strongly Agree	**Agree**	**Disagree**	**Strongly Disagree**
1	I feel that I am a person of worth, at least on an equal basis with others.	1	2	3	4
2	I feel that I have a number of good qualities.	1	2	3	4
3*	All in all, I am incline to feel that I am a failure.	1	2	3	4
4	I am able to do things as well as most people.	1	2	3	4
5*	I feel I do not have much to be proud of.	1	2	3	4
6	I take a positive attitude toward myself.	1	2	3	4
7	On the whole, I am satisfied with myself.	1	2	3	4
8*	I wish I could have more respect for myself.	1	2	3	4
9*	I certainly feel useless at times.	1	2	3	4
10*	At times I think I am no good at all.	1	2	3	4

Table 4: The RSES scale.

Appendix B- Sensitivity Index (for boys)

Appendix C- Bonferroni Adjustment