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Impact of Innovative Menstrual Technology and Awareness on Female Empowerment Outcomes in Rural Nepal

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Abstract: In developing countries, menstruation poses two significant challenges for females. First, the resources required for periods are expensive for those in low-income communities. Hence, the absence of such menstrual products lowers females' access to schooling and employment. Next, periods are also heavily stigmatized – especially in poorer or rural areas. Such taboos surrounding menstruation negatively impacts females' psychological development and hamper their prospects of socialization. Thus, to analyze this issue, we ran a randomized control trial in Nepal, where we provided reusable menstrual pads and / or health seminar to 312 schoolgirls and 100 of their mothers. Our outcomes demonstrate that the reusable pads cause a significant decline in school absenteeism for schoolgirls in our sample. However, we are also able to find a heterogeneous impact of our treatment, where females from poorer households seem to benefit disproportionately from our menstrual resource. In contrast, the health seminars do not impact school attendance, but do create statistically significant increases in the social and psychological wellbeing of the schoolgirls. Finally, we are unable to identify any impact of our treatments on mothers in the sample.

1. Introduction and Motivation

1.1 Anatomy of Menstruation: Science and Society

The menstrual cycle is a monthly process in which female hormones stipulate the ovaries to release an egg and thicken the lining of the uterus for pregnancy. However, in the absence of required fertilization, these hormones alternatively cause the uterus to shed this thickened lining in the form of blood and tissue. This final stage of the process is called menstruation (informally: periods), and it allows the body to episodically continue the menstrual cycle until menopause. Females typically experience Menarche[1] at the age of 12 and continue to have periods until menopause for 5 days per month (EKS National Institute of Child Health and Human Development, 2017)[2]. Thus, through strictly scientific lenses, menstruation is a biological phenomenon that facilitates the body's reproductive needs by preparing the female body for childbirth.

However, there is a significant discrepancy in the impact and perception of menstruation in developed versus developing countries. In the former, menstruation is extremely manageable and contextually normalized. However, in the latter, menstruation imposes a resource burden upon females in low income communities and is heavily stigmatized through numerous avenues of cultural and traditional malpractices (Aro and Kadariya, 2015). For example, UNICEF's report shows that in Nepal, 86% of the surveyed schoolgirls had to stay away from their kitchen, 68% had to avoid both private and public religious spaces, 41% had to avoid all physical contact and 28% had to live outside of their homes when menstruating (UNICEF, 2014).

Specifically, in the Far-Western and Mid-Western Development Regions of Nepal, many females are forced to practice *Chhaupadi* – a tradition in which menstruating females live outside of their homes in menstrual huts as large as 1X2 meters or in animal sheds called *Goths*. Not only is this practice of *Chhaupadi* correlated with significant health complications like pneumonia, suffocation, respiratory tract infection, higher rates of prolapsed uterus, as well as neonatal and maternal mortality, it also makes females vulnerable to animal attacks, sexual assault, social ostracization and psychological/emotional distress from prolonged stages of social isolation (Aro and Kadariya, 2015; Bhartiya, 2013). Unfortunately, such practices remain highly prevalent in certain parts of the country, despite being completely outlawed by the Nepal Supreme Court in 2005 (The Guardian, 2017).

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[1] Menarche: Menarche is often defined as the start of a woman's reproductive life or her first period (Lawn, Lawlor, Fraser, 2018; Nielson et.al. 2017).

[2] These statistics have been extracted from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (updated: 2017) and pertain to females in the United States. There could be potential differences in these averages for females in other countries. Depending on nutrition levels and access to health services, females may experience menstruation differently than described in this study. No relevant statistics of the same nature are available for Nepal.

Such legislative policies often fall short of creating broader social changes, as they are unable to address the deeper underlying inequalities that exist within Nepalese society (Nightingale, 2011). The numerous challenges associated with menstruation are highly symptomatic of poverty and knowledge-scarcity – in 2017, the World Bank reported Nepal's GDP per capital to be $729.1, while the UNDP ranked the country at 144 out of 188 on the Human Development Index (World Bank, 2017; UNDP, 2015)[3]. Thus, if females suffer from a shortage of menstrual resources due to poverty, then they are unable to manage their periods efficiently. Furthermore, if menstruation is surrounded by taboos and misinformation, females are effectively viewed as "polluted" during their periods and are socially ostracized. The combined loss of capacity, opportunity and socialization could translate into long-term costs in education, employment and wellbeing for these females.

Therefore, the interconnection between lack of sanitary products and economic / social outcomes, has garnered a lot of attention from organizations, policy makers and the media. In 2018, the government of India launched *Suvidha* – a low cost sanitary napkin that is 100% biodegradable and is available at a reduced price: $0.038[4] per pad (The Economic Times, 2018). Similarly, in 2012 the Kenyan Prime Minister allocated almost $3 million[5] for sanitary napkins in low income communities through the Primary Schools Sanitary Towels Program (NPR, 2016). On the other hand, numerous NGOs and IGOs have also repeatedly stated the importance of providing physical and structural resources to girls during their periods (UNESCO, 2014; UNICEF, 2012; WaterAid, 2009).

Surprisingly, there is no set consensus in the academic field about the relationship between menstruation (generally) and the determinants of female empowerment. Researches that access the impact of improved menstrual technology on determinants like school absenteeism have often found the main driving mechanism of school attendance to be poverty levels and broader gender inequalities (Grant, Llyod and Mensch, 2013; Oster and Thornton, 2011; Sommer, 2010; Scott el al., 2009). On the other hand, studies have also highlighted the importance of support networks and contextual / cultural information about the females' "lived experiences" with menstruation (Malasu and Zani, 2014; Jewitt and Ryley, 2014; Mason et al, 2013; Sommer, 2010). Such contradictory outcomes make it difficult for policy makers and donors to actively create public health policy and interventions into female empowerment via menstrual resource provision and subsidization, respectively.

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[3] World Bank Table: GDP per capita (current US $) – World Bank Open Data
https://data.worldbank.org/indicator/NY.GDP.PCAP.CD
UNDP Table 1: Human Development Index and its components
http://hdr.undp.org/en/composite/HDI

[4] The exchange rate is 0.0151 US dollar per 1 Indian Rupee in April, 2018. This statistic can be found at CNN money website: http://money.cnn.com/data/currencies/

[5] The exchange rate is 0.010 US dollar per 1 Kenyan Shilling in April, 2018. This statistic can be found at CNN money website: http://money.cnn.com/data/currencies/

Thus, to test for the value of subsidized menstrual resources, we carried out a field-experiment in the Far-Western Development Region of Nepal[6]. This region, called the *Sudhur Paschimanchal Bikas Kshetra*, covers 19,539 square kilometers and has its headquarters in Dipayal, Doti. Often considered to be extremely underdeveloped, this region is home to complex social institutions in the Nepalese culture. While, both caste and gender discrimination are prominent, this region is especially infamous for its harsh *Chhaupadi* practices surrounding menstruation (Gautam, 2017). Thus, we selected four schools from within this region and invited the schoolgirls and their mothers to participate in our study.

Following the selection process, we induced two main treatment variables. First, we introduced a low-cost, reusable sanitary pad called AFRIPads. This treatment seeks to address the underlying menstrual issues of cost and disposal. Not only are periods products expensive for females, often schoolgirls have nowhere to dispose of them because of a lack of trashcans at school. Second, we also gave a health seminar to the females in our study. Through this treatment, we wanted to de-stigmatize the process of menstruation via information, while simultaneously providing psychological and emotional support for the participants. By the end of the study, all subjects received both treatments.

The schoolgirls who were given AFRIPads showed a significant decline in school absenteeism by 0.693 school days over a period of five months. However, interestingly, schoolgirls from the government-run schools that generally come are from poorer households, benefitted disproportionately more from the reusable pads. We observe a decline in school absenteeism by 1.147 school days over a period of five months for this subset of the subject pool. Our health seminars also created a statistically significant increase in schoolgirls' social and psychological wellbeing as well. This wellbeing index increased by, 0.666 units for girls who received the seminars and by 0.812 units for girls who received both the seminars and the reusable pads. However, we were unable to find any evidence that the reusable pads or the health seminars were beneficial to the wellbeing of the girls' mothers. Overall, these results reiterate the narrative put forth by numerous NGOs on the field, as well as qualitative studies conducted on the area, which point towards the negative impact of menstruation on female empowerment. Our study shows that the reusable menstrual pads specifically create schooling opportunities for females from low-income households enrolled in government schools, whereby girls significantly close the absence gap between them and their private-school counterparts in the presence of such resources. On the other hand, the health seminar benefits all girls in the study, as the treatment addresses a homogenous cultural group by de-stigmatizing the phenomenon of menstruation.

[6] **Appendix**: Figure 1 in the appendix displays the Far Western Development Region of Nepal. Source: https://beautifulfarwestnepal.blogspot.com/2015/04/map-of-far-western-development-region.html

In Section 2 of this paper we will provide a literature review of previous work conducted on this topic. Section 3 explores the research design, which encompasses the subject pool, location, timeline, experimental design and a description of all our treatments. Section 4 will provide information about our methodology, which focuses on the research question, hypothesis, variable construction and data. Section 5 will present the empirical strategy adopted by this paper, in terms of model specifications. Section 6 will present our complete results, which will be further critiqued in Section 7. Finally, we will present all relevant discussions and conclusions in Section 8.

2. Literature Review

2.1 Normative Review: The Genealogy[7] of Menstrual Taboo

In order to combat social challenges, we must first understand the systems that create and uphold such challenges in the first place. Therefore, we briefly explore the origins of menstrual stigma generally – and then in-depth, with respect to Nepal. Much of this literature addresses the taboos surrounding menstruation through its relationship with religion, culture, power systems and asymmetric gender roles (Strassmann et al., 2012; Bhartiya, 2013; Manhas and Salem, 2015; Selvi and Ramchandran, 2012; Nightingale, 2011).

Almost all religions in the world have stigmatized periods – in Judaism, the code of Law: *Halakha,* states that women undergoing menstruation: *Niddah,* are 'unclean' and have to partake in *Miqveh*, a ritual bath to become pure (Wasserfall, 1999). Within the Eastern Orthodox Christian church, the Russian denominations practice customs quite similar to *Chhaupadi,* where women also live in isolated huts (Bhartiya, 2013). In Islam, the Quran finds menstruating women to be impure: 2.22 reads, "*They ask you about menstruation. Say, 'It is an impurity, so keep away from women during it*…", and females are forbidden from praying or fasting during their periods (Manhas and Salem, 2015; Bhartiya, 2013).

Furthermore, in Hinduism, a religion which is practiced by 81.3%[8] of the Nepalese population (Central Bureau of Statistics – Nepal, 2016), menstruation is considered to be a sin. In the Hindu mythology, menstruation: *Rajaswala Dosha* began when the king of the Gods: *Lord Indra* distributed his sin amongst the land: *prithvy*, the oceans: *samundra* and the women: *stree*. Thus, menstruation is seen a fault: *Dosha*, and females experiencing menstruation are seen as the inheritors of Lord Indra's original sin. Similarly, in the Hindu Yogic philosophy, which is partially a function of Hindu mythology, every individual is believed to possess three qualities: *gunas*. These are: (i) black guna: *tamas*, (ii) red guna: *rajas* and (iii) white guna: *sattva*. The black *guna*, which comprises of all forms of excretion from

[7] Genealogy: An account of the origin and historical development of something, Merriam-Webster dictionary (2018).
[8] The Central Bureau of Statistics in Nepal publishes figures for major demographic and social data. The figure presented can be found in their publication at: http://cbs.gov.np/image/data/2017/Nepal%20i%20Figures%202016.pdf

the body – like blood, sweat, tears or menstrual blood is categorized as *Tamas*, which translates into darkness or obscurity. Therefore, over time and culture, the act of touching a menstruating female becomes a dark act: A *Tamasic* act (Bhartiya, 2013). Such deep-rooted religious and mythological beliefs slowly manifest themselves as discriminatory and harmful traditions in the present-day Nepalese society.

Numerous authors in the literature have also pushed the idea of a feminist political ecology – especially, the notion that gender and nature[9] are deeply interdependent, both culturally and historically (Jewitt and Ryley; 2014; Nightingale, 2011). Nightingale (2011) argues that there are symbolic identities for spaces, practices and bodies that are reproduced in everyday activities like agriculture, harvesting, preparation of food and consumption. In Nepal, menstruating women face physical isolation, where a geographical radius of space is constructed between them and the rest of society. This presupposes the idea that certain spaces like homes, kitchens and religious monuments are "pure" and subjectively superior. Thus, menstruating women, who are considered to be impure and polluted, are expelled from these spaces. Furthermore, with respect to this finding, Jewitt and Ryley (2014) construct "emotional geographies" of menstruation and puberty. Through this, they are able to investigate the cultural and spatial limitation of "lived experiences" for females and identify the necessity for policy to be dynamic and contextually relevant to spatial differences between the schoolgirls in the research.

Overall, while the normative literature deals with multiple religions, cultures, customs and areas, the underlying enforcement of stigmatization comes down to the exercise of power (Bhartiya, 2013; Strassmann et. al, 2012; Nightingale, 2011). Very often gender discrimination occurs in the absence of females' bargaining power. In the case of menstruation, Nightingale (2011) qualitatively demonstrates the inability of Nepalese women to "renegotiate the old spatial boundaries" during their periods. Similarly, Strassmann et al. (2012) study the genetic data on paternity for the Dogon of West Mali, in West Africa to show how enforcement of menstrual stigma – i.e. forcing women to disclose their menses status by going to the menstrual huts, acts an honest signaling mechanism that upholds patriarchal reproductive agendas and high paternal certainty[10] in traditional communities (Strassmann et al., 2012). Thus, the normative literature suggests an ingrained and systemic stigmatization of menstruation that is deeply embedded in society, culture and identity. This begs the question of whether solely providing physical menstruation products to schoolgirls, while essential, is enough to combat the multidimensional challenges of menstruation in developing countries.

[9] The use of the word nature does not simply refer to the natural world; rather a state of the world (Jewitt and Ryley, 2014; Nightingale, 2011; Bondi and Davidson, 2003; Longhurst, 2003).
[10] Paternal certainty has high returns in societies like Mali, where polygamy is legal and socially accepted.

2.2 Theoretical Review: Modelling the Costs of Menstruation

The Cost of Resource Scarcity on Human Capital Growth

The Oxford Dictionary has defined human capital as, "the skills, knowledge and experience possessed by an individual or population, viewed in terms of their value or cost to an organization or country." Goldin (2014) states that is possible to make investments into people (via education, health, training etc.) that increase the productivity of individuals and foster overall economic growth. In fact, the necessity of human capital for economic development has been well documented (Kalemli-Ozcan, 2006; Galor and Moav, 2003; Cervellati and Sundae, 2002; Barro, 2001; Chapman and Withers, 2001; Benhabib and Spiegel, 1994). Beginning with models trying to explain Europe's escape from the Malthusian equilibrium, endogenous growth models incorporating technological advancements and fertility transitions have been founded upon the role of human capital in driving the economy (Galor and Weil, 2000; Galor, 2011).

For instance, Kalemli-Ozcan (2006) proposes an OLG model where parents' precautionary demand for children decreases due to exogenous decline in mortality (technological progress), and therefore, they invest heavily in their surviving children's health and education. The results mimic a hump-shaped relationship between population growth and survival possibility, suggesting the positive role of human capital accumulation in economic progress. Similarly, through a "overlapping-generations" model, Galor and Moav (2003) find that during the industrial revolution, when physical capital was dominant, inequality actually promoted growth by streamlining resources to those with a higher propensity to save. But in the later stages, when returns to human capital are high, due to the capital-skill complementarity, human capital replaces physical capital as the driving engine for growth. Hence, theoretically, human capital development is essential for economic growth.

Education Outcomes

Thus, given such a prominent relationship between development and human capital, we will now explore avenues of investment into human capital formation – mainly through female education. Cervellati and Sundae (2002) stimulate a demographic transition in their S-shaped development trajectory, exactly where the economy becomes stable enough to withstand the once-prohibitively high costs of education. They find that such education changes have crucial implications for the education decisions of future generations – both, in terms of life expectancy and productivity changes. On the other hand, Barro's (2001) extended neoclassical model of growth, where the growth rate is inversely related to the per capita product; but positively related to the long run level of output, also suggests the optimistic impact of education on human capital accumulation. This is especially true for female education, as it substantially lowers the fertility rate in the model.

Similarly, there are abundant studies linking female education to lowered fertility rates, and indirectly to economic development. Klasen (2002) reviews this impact through three main mechanisms: (i) Lowered fertility rates reduce population growth (Tembon and Fort, 2008; World Bank 2001; Sen 1990), which increases the ratio of capital per worker. Hence, there is an overall increase in the growth per capita (Solow, 1956). (ii) Lower fertility rates also result in lower levels of economic dependency upon females, which can instead be put towards savings and investment by either the income or substitution effect (Weil, 2009; Barro, 1996). (iii) Lowered fertility rates could also cause an influx of workers into the economy in the short-run, as females can utilize their time in the labor market, instead of raising children. This effect could translate into higher demand for production, investments into capital and infrastructure and incentives for foreign investment (Weil, 2009).

Therefore, if the cost of menstrual products in developing countries acts as a barrier to female education – i.e. girls miss out on educational and employment opportunities because they are unable to efficiently manage their periods and attend school or work, then such economic challenges of menstruation are a barrier towards women becoming a vital part of the human capital of their communities. Consequently, it also becomes a barrier for females' independence and self-determination.

Health Outcomes (Briefly)

Another significant investment into human capital exists in the domain of female health. Bloom et al. (2015) utilize a dynamic general equilibrium framework to show that improvements in female health, which is based on wage rate, continue to lower the threshold for demographic transition and accelerate the economy towards the point of "take-off". They also find this result to be theoretically robust to introducing collective household preferences, endogeneity of health interventions within households and controlling for physical capital in their production function.

However, as our own study introduces a technological advancement in female menstrual health, the applicable, theoretical literature is concentrated in the impact of the birth control pill. Goldin and Katz (2002) illustrate the impact of the first birth control pill Enovid, approved by the FDA in the 1960's. Their model suggests that this technological advancement benefited women through a social mechanism – the pill had a "social multiplier" effect, such that, it created a new equilibrium in which marriages are later, careers are more prominent, and matches are "better" for women. Thus, the result proposes a supply-driven justification for the changes in females' decision regarding education and fertility that is created by the availability of safer, more convenient and more efficient option for controlling their fertility. Thus, we would argue that such a technological, supply-driven justification holds for menstruation as well.

2.3 Empirical Review – Identifying the Costs of Menstruation

Schooling and Wellbeing

Much of the empirical literature on the topic of menstruation is concentrated on demonstrating impacts upon school attendance, access to employment opportunities and the social and psychological welfare of females. As all of these variables are highly volatile in composition, it is no surprise that empirical studies often find contradictory outcomes. Even the normative review has reinstated the necessity of understanding subjectivities that affect the subject pool of the studies when creating and evaluating treatments.

The most rigorous RCT conducted by Oster and Thornton (2011) finds no significant impact of providing Nepalese schoolgirls with menstrual cups on school attendance or test scores. They argue that the impact of menstruation on schooling is very small – i.e. girls tend to miss 0.4 days out of a school year due to their periods. Thus, period products do not significantly help close the attendance gap (Oster and Thornton, 2011). This finding is replicated by Grant, Llyod and Mensch (2011) who also utilize the Malawi Schooling and Adolescent Survey to report a lack of school-level variance in menstruation related absenteeism (Grant, Llyod and Mensch, 2011). On the contrary, Montgomery et.al. (2016) find a positive impact of reusable sanitary pads in rural Uganda. Through a randomized control trial including 1124 girls, the authors find the post-treatment attendance levels to be for worse for girls across all arms. However, the pre-protocol analysis revealed that the decline in school attendance was much worse for subjects in the control arm than for those in the treatment arm by 17.1% (Montgomery, 2016).

Consistency regarding positive outcomes in the empirical literature is scarce. The critics have often pointed out methodological or theoretical concerns with the legitimacy of results. For instance, Montgomery's study suffered from high drop-out or transfer rates, which translate into systemic challenges for the results (Montgomery, 2016). On the other hand, Sommer (2010) points out that, while the results of the Oster and Thornton's paper makes a significant contribution to the literature, one must be cautious to over generalization. In particular, this is due to the taboo surrounding "vaginal insertion" in many cultures. It may also be interesting to note that such cultural differences may exist not only between countries, but also within countries. Gellner, Pfaff-Czarnecka and Whelpton (1997) discuss the organization of ethnic categories in Nepal. They discuss the "sheer diversity of identities which Nepalese can being into play because historically the unification of Nepal has rested upon interethnic cooperation, but not assimilation. In such culturally diverse countries, traditions, norms and culture are broken down by numerous variables like ethnicity, geography and socio-economics. This makes it increasingly difficult to find a singular source for impact assessments of menstrual technologies.

Therefore, the empirical field is also rapidly moving towards more qualitative methods of analysis. The most common empirical researches utilize sampling, focus group analysis, and structured-interviews. Jewitt and Ryley (2014) utilize field data from Kisumu, Kenya to closely link menstruation to absenteeism. They find that periods affect attendance through two key elements in the study. First, there is an economic barrier to school attendance during periods. In the event of staining, most schoolgirls may ruin the singular set of school uniforms that they own. Furthermore, as most participants did not use or could not afford to use menstrual pads, rags and cloths made this problem even more prominent. These findings are replicated in Mason et al (2013), who demonstrate that females in their dataset often coped with the absence of menstrual resources like pads (due to poverty), by exchanging sexual favors. Furthermore, from discussions with their 11 focus groups, it was also clear that girls in rural areas were often unprepared for their menarche and generally lacked preparation for their menstruation. They refer to this as a "knowledge gap" for menstruating females in marginalized or low-income communities, when compared to their more affluent counterparts. Thus, the fear of staining, as pointed out by Jewitt and Ryley (2014), is a very prevalent concern for the girls and is differentiated by socioeconomics.

Second, these authors also argue that a key area where menstruation affects schooling is through the psychological and emotional aspects of menstruation. Often schoolgirls are teased and embarrassed during their periods. These findings have been replicated in the work of McMahon et al (2011). Their data collected from six schools in Kenya demonstrates that the most prominent responses from focus groups were about embarrassment and shame. Through in-depth interviews, the authors conclude that periods often signal change in females' sexual status. Thus, in cultures that are heavily influenced by communalism or conservatism (a Kenyan national survey finds that less than 50% of parents ever discusses any sex-related topics with their children – Eisenberg, 2006), menstruation becomes a phenomenon of embarrassment. Therefore, schoolgirls may miss school during periods, but use the popular euphemism of "sickness". It has also been pointed out that estimates regarding the impact of menstruation, which, rely on self-reported data maybe downwards biased if females miss school due to menstrual challenges but report them as "sickness".

Overall, the empirical literature is highly contradictory. The subjectivities of measuring the impact of menstruation on determinants of female empowerment can vary based on the subject pool, the location and even the experimenter's perception of empowerment. While empirical studies that rely heavily on administrative data fail to find any impact of menstruation or menstrual products, the studies that incorporate structural data do find impacts.

3. Research Design – The Experiment

3.1 Timeline, Location and Subject-Pool

Our study was conducted from August 2017 to January 2018 in Johanpur, Nepal. Jonahpur falls in province 7, Kailali district of Nepal's Far-Western development region, which is an area of high problem prevalence (UNICEF, 2014). We included 312 schoolgirls enrolled in grades 8 – 10, and 100 mothers from four randomly selected schools in the area. We administered surveys for all participants, which was designed to collect demographic, academic, economic, biological, social and psychological data.

Following this, we randomly assigned participants to three treatment arms (T1, T2, T3) and one control arm (C). However, as two of the selected schools were government-owned, while two were privately-owned, we had to address any potential heterogeneity between subjects in these schools – the girls enrolled in the government schools came from much poorer households or socially ostracized ethnic backgrounds. Thus, we chose to block-randomize[11], i.e. each arm contained schoolgirls and mothers from within each school. Figure 2 in the appendix illustrates the organization of this randomization. While Table 1 illustrates the balanced number of participants in the treatment and control groups, Table 2 illustrates the number of mothers and daughters in all treatment and control groups.

3.2 Structure of the Random Assignment and Blocked Randomization

The biggest challenge to assigning causal estimates in an experiment lies in the ability to control for any form of selection bias[12] within the study:

$$\text{Selection bias: } E[Yo_i \mid D_i = 1] - E[Yo_i \mid D_i = 0]$$

Here, the expectation (E) of potential outcomes for individual 'i' (Yo_i), is different given the event of endogenous selection ($D_i = 1$) or non-selection ($D_i = 0$) into the treatment. Thus, by simply analyzing the difference in outcomes for females who use menstrual pads against other females at baseline produces biased estimates due the influence of significant endogenous factors (examples: household income, religion, ethnicity etc.) on the subjects' decisions. Thus, random assignment acts as a source of exogenous variation, where each participant has an equal probability of being treated. For instance, in an experiment with N subjects, we assign m to the treatment group, such that, $0<m<N$, and each unit has the probability m/N of assignment to treatment.

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[11] Block randomization: An advantage of blocked randomization is that treatment groups will be equal in size and will tend to be uniformly distributed by key outcome-related characteristics (Efird, 2011).

[12] Selection bias: Selection bias occurs for two distinct reasons. (i) When subject self-select into treatment based on endogenous factors and (ii) Through specification errors (Heckman, 1977).

Specifically, under random assignment the selection into treatment is orthogonal to potential outcomes: $D_i \perp Y_i$. Therefore, this allows us to generate an unbiased average treatment effect (ATE).

$$\text{ATE: } E[Y_i(1) - Y_i(0)] = E[Y_i(1)] - E[Y_i(0)]$$

Under random assignment:

$$E[Y_i(1) \mid D_i = 1] = E[Y_i(1) \mid D_i = 0] = E[Y_i(1)]$$

$$E[Y_i(0) \mid D_i = 0] = E[Y_i(0) \mid D_i = 1] = E[Y_i(0)]$$

Therefore, the ATE is estimated as:

$$\text{ATE} = E[Y_i(1) \mid D_i = 1] - E[Y_i(0) \mid D_i = 0]$$

In our experiment, where we have the ability to randomly assign units, we can place m subjects in the three treatment arms (T1, T2, T3), and $N - m$ subjects in the control arm (C), such that, it is possible to analyze the average outcome over all possible random assignments:

$$\frac{E[Y_1] + E[Y_2] + \ldots + E[Y_m]}{m} - \frac{E[Y_{m+1}] + E[Y_{m+2}] + \ldots + E[Y_N]}{N-m}$$

$$= E[Y_i(1) \mid D_i = 1] - E[Y_i(0) \mid D_i = 0]$$

$$= E[Y_i(1) - E[Y_i(0)]$$

$$= \text{ATE}$$

Therefore, the average treatment effect (ATE) can now be estimated through a comparison of means between the treatment (T1, T2, T3) and the control (C) arms, with any unbiased statistical estimator. However, as aforementioned in 3.1, in order to control for potential heterogeneity in the subject pool between girls enrolled in private versus government schools, we randomly assign within blocks – i.e. the four schools in the study. So, instead of enforcing the randomization process over the entire subject-pool, we divide the participants into homogenous groups and then randomize herein. This helps ensure that the variables of interest are balanced within these strata and the estimates are precise. Furthermore, one of the biggest advantages of blocked randomization on variables is that it strongly predicts outcome. This is certainly true for our experiment and will be discussed further in the results section.

3.3 Introduction to Treatment and Intervention Relevance

After concluding the process of random assignment, we administered the respective treatments to the subjects within each arm. Table 3, in the appendix, outlines our treatment matrix. As illustrated, the structure is broken down into groups that received: (i) reusable sanitary pads (T1: AFRIPads), (ii) health seminar (T2: Seminar), (iii) reusable pads and health seminar (T3: Both) or (iv) neither treatments (T4: None).

3.3.1 Treatment Arm I: Innovative Menstrual Technology – AFRIPads

Subjects in treatment arm I (T1: AFRIPads) were provided with a reusable sanitary pads that can utilized for 12+ months. We specifically utilized AFRIPads[13], as its features are exactly suitable in the context of our study. Figure 3, in the appendix, shows the process of utilizing an AFRIPad kit and sheds light on how this particular product was appropriately targeted for the demographic of this study. Further, as seen in Figure 4 in the appendix, 61.893% of the subjects reported the cost of regular menstrual products to be too high. On the other hand, 61.859% of the females reported having disposed of their used menstrual products in the river. Even within schools, while 75.641% of the school girls had access to a private restroom, there were 0 trashcans, 0 soaps and 0 nurse's offices in schools. Therefore, AFRIPads that are (i) low cost – a single AFRIPads kit has 4 reusable sanitary napkins and is available at a unit price of $4.40, (ii) reusable, (iii) do not require disposal and (iv) is customized to fit the body's differing menstrual needs, addresses the overall state of the problem; as directly reported by the subjects and as reflected in the data.

3.3.2 Treatment Arm II: Informative Health Seminar

Subjects in treatment arm II (T2: Seminar) were provided with an informative and activity-based health seminar. Figure 5, attached to the Appendix, highlights the impact of menstrual stigmatization, as seen through our data. On a scale of 0 – 5, there are low levels of confidence (2.686), self-esteem (2.616) and socialization (2.766) during periods. On the other hand, we simultaneously find high levels of teasing (77.243%), isolation (3.004), embarrassment (3.434) and feeling polluted while menstruating (3.266). Thus, our health seminar addresses the reported challenges by (i) providing biological context surrounding periods, (ii) normalizing menstruation by addressing issues of shame, (iii) providing structural support during menstruation by establishing a direct line of contact between numerous NGO(s) that can be contacted in the event of isolating practices or bullying and (iv) games that interactively created a safe space for females to verbalize their concerns about periods.

[13] More information on AFRIPads can be found at: https://www.afripads.com/our-products/
Furthermore, we have attached *Figure 3.3.1* in Appendix 2 that demonstrates the process of continuously using the AFRIPads.

3.3.3 Treatment Arm III: Both Treatments, and Control Arm: None

Finally, subjects in treatment arm III (T3: Both) were given, both, AFRIPads and the health seminar, while subjects in the control arm (C: None) were given neither of the aforementioned treatments[14]. The control group of females effectively act as our counterfactual group who are, on average, identical to the girls in the three treatment arms – i.e. there exists no reason for the females in these four groups to have systemic differences between them. Hence, the comparison of means between the treatment and control groups, provide us a with an unbiased mechanism of measuring the average treatment effect (ATE) of the reusable sanitary pads and the health seminar on our variables of interest / indicators of female empowerment.

4. Methodology: Research Question, Hypothesis and Data

4.1 Research Question

Based on the research design, we are now able to explore: Does subsidizing the cost of menstrual products and normalizing the stigma surrounding periods have any meaningful impact on females' economic prospects? Therefore, our hypotheses can be categorized by our two treatments, as they have been constructed to fit the two big challenges faced by Nepalese females, in the context of menstruation.

4.2 Hypothesis

4.2.1 Reusable Pads: Addressing the Resource Burden of Menstrual Products

As we provided reusable sanitary pads (AFRIPads) to the schoolgirls in our study, we want to access whether this subsidized menstrual resource has any statistically significant impact on the schoolgirls' attendance and test scores over 5 months. Therefore, we have two testable hypotheses[15]:

(i) Ha_1: The provision of AFRIPads declines school absenteeism.

(ii) Ha_2: The provision of AFRIPads increases test scores.

4.2.2 Health Seminar: Addressing the Stigmatization of Menstruation

Since we also organized a health seminar, we want to access whether providing schoolgirls and their mothers with information, awareness and structural support has any statistically significant impact on their overall social and psychological well-being. Therefore, we have one testable hypothesis:

(i) Ha_3: The provision of the health seminar increases overall well-being.

[14] It should be noted that at endline, females in all arms (T1, T2, T3, C) were given both treatments.

[15] We have provided a list of our alternative hypothesis. The null hypothesis for each statement is simply the converse.

4.3 Data

4.3.1 Variable Construction

We have three main variables of interest: (i) School attendance: The data on school attendance is collected from each schools' attendance registers. We recorded the total number of absences for the subjects within a span of 5 months from baseline. (ii) Well-being: We included a dependent variable based on the social and psychological wellbeing of the subjects in our study as well. Jewitt and Ryley (2011) write, "Emotions are part and parcel of how subjects' access and utilize the resources available to them." In order for females to effectively benefit from subsidized resources, we have to address their social and mental concerns surrounding periods. Thus, our wellbeing variable is an Index[16] generated from the self-reported scores for (1) confidence, (2) self-esteem, (3) socialization, (4) isolation, (5) embarrassment and (6) feeling of being polluted, on a scale of 0 – 5 from our survey[17]. For example, the questions were phrased as, "On a scale of 0 – 5, how confident do you feel during your periods?" Table 4, in the appendix, provides a list of the psychological and social questions that make up subjects' scores on the well-being index. Furthermore, the vectors of scores were 'corrected' to face the same direction, while the scores themselves have been normalized in order to make meaningful inferences from the regression coefficients. (iii) Test scores: This variable captures data on cumulative test scores, on a range of 0 – 100%. These scores were recorded for the last exam taken by all schoolgirls.

However, it is also very significant to address the limitations of our variables in capturing the true nature of the data. First, our data on school attendance is based on the resources of the school administration. Therefore, we are unable to control for any inaccuracies of such a measure, should there be internal biases or any over/under-reporting (Times of India, 2016). Second, our well-being index is generated through self-reported scores on subjective measures of welfare. Therefore, any discrepancies that may exist between the reported versus actual scores, due to any cognitive or psychological biases, have to be acknowledged (Gorber et al., 2009; Spencer et al., 2007). Finally, our measure of test scores may be potentially uneven across subjects as the data is not generated from a standardized source. The quality of tests and the validity of the scores might not be homogenous across individuals in our dataset depending on systemic factors like spatial differences (Pope, Sydnor, 2010; Rabinovitz, 2016). For instance, in Nepal, tests taken by children in private versus government schools vastly differ in quality and difficulty and might not be completely synchronized for analysis.

[16] We create an Index in order to generate a singular score for each individual's social and psychological outcomes during menstruation, which is robust to over-testing. Thus, by combining such scores into a single index we are able to lower the probability of making a Type I error.

[17] These questions can be found in Social and Psychological Module of the Surveys that have been attached to Appendix 2.

Another significant challenge lies with our baseline data. The research suffers from chronic problems with the accuracy and consistency of variables at baseline. For instance, some variables have been over or underestimated – either during the process of data collection or during the process of data entry. At baseline, variables of interest like confidence and self-esteem have an upper limit of 7, even though the variable has only been coded on a scale of 1-5. Other variables like embarrassment or isolation have a lower limit of 0, even though the actual variables have only been coded on a scale of 1 – 5.

Furthermore, the data on absenteeism also suffers from the problem of missing data that is concentrated on particular schools and particular classrooms. Such data cannot be assumed as being "Missing at Random" (MAR). Furthermore, the inconsistencies have a similar underlying pattern of being collected by the same enumerators. Instead, the challenges with our data at baseline have to be labelled as being systemic or chronic. Thus, the missing data have to be considered as being "Missing Not at Random" (MNAR). Such missing data can cause serious bias in the estimation of results. This is because when data is missing from the dataset, it ends up being underrepresented in the estimation. Therefore, the analysis often skips out on certain significant aspects of the phenomenon at hand (SPSS, 2009). This is problematic in our case. As the data on absence is missing for a specific group of girls, there might be something categorically different about this subgroup of girls in our dataset that is not being controlled for; leading to possible bias.

Furthermore, we also face serious challenges regarding demonstrating causality of our impact in the absence of baseline data. In any RCT, causality is dependent on the overall balance between treatment groups, whereby the groups are comparable in reference to the outcome of the treatment. As our estimates of all variables of interest: absenteeism, grades and wellbeing index (6 compositional variables) are all systematically biased at baseline, we cannot fully identify impact. Therefore, the best possibility lies in showing balance among treatment and control groups through other collected variables that do not suffer from the same challenges. In the next subsection: 4.3.2 we present the summary statistics for our study. Through time-invariant variables capturing information like age, menstrual product use, government vs. private school enrollment, days into the menstrual cycle, marital status, religious household composition and ethnicity, we try to capture the picture of balance across all 3 treatments and 1 control arm at baseline.

Furthermore, during the analysis of the impact, we will also try to demonstrate the balance at baseline through our variables of interest that show no significant change due to our treatments. In such cases, we can show plausible evidence that the balanced state of variables across all four treatment arms, post-treatment, indicates balance at baseline for all T and C groups, making them comparable for impact evaluation of our study.

4.3.2 Summary Statistics: Balance and Descriptive Overview

Table 5, in the Appendix, presents our summary statistics, categorized by mothers vs. daughters, and private vs. government schools. As demonstrated by the summary statistics table, the age of the subjects within each treatment group was relatively balanced. On average, the mothers were about 38 years old, while the daughters / schoolgirls were 14 years old in the sample. Next, we can observe that females in our dataset predominantly utilized cloths / towels when menstruating. However, this holds true more for mothers than daughters. 75% of the mothers and 60% of the daughters primarily utilized cloth during their periods. Thus, there already seems to be a gradual, generation shift in the methods used by females in our dataset to manage their periods.

In addition to this, we also broke down the menstrual resource utilized by the subjects based on our income proxy. Due to certain restrictions in our data collection process, we were unable to collect reliable economic data from the mothers and daughters in our study. Therefore, as a proxy for the income level, we decided to utilize the status of the schoolgirls' enrollment in private vs. government schools to categorize their income level. The largest differentiating factor between the females enrolled in these two types of schools is the difference in their household's capability to fund quality education (Alderman, Orazem, Paterno, 2001). Hence, our data shows that almost 57% of the schoolgirls in privately-owned schools utilized cloth during their periods. Whereas, almost 70% of their counterparts in government-owned schools did so as well.

Furthermore, in order to further confirm balance within the groups, we also categorized the menstrual cycle information of the females in our dataset, by treatment arms. As seen in Table 5, on average our subjects fell right in the middle of the menstrual cycle, as all categories center around 14 days for both mothers and daughters. Further, we also find that within our treatment arms, on average, 11.831% were ethnically Magar, 4.489% were Chettri, 3.215% were Brahmin, 2.608% were Gurung and 2.380% were Tharu. However, even though our subject pool was heterogeneous in income level, it was largely homogenous in social, religious and cultural makeup. It can be seen that, across treatment arms, the mothers in our sample overwhelmingly defined their marital status as "married", and the daughters as "unmarried". In addition to this, it should also be noted that our subject pool was almost 95% Hindu in composition for private schools and 98% for government schools. Such consistencies and differences in our dataset should be considered, when conducting data analysis with the variables of interest.

Finally, the balance among the 4 arms in terms of time-invariant factors like ethnicity, household religion, days into menstrual cycle, marital status and enrollment in government vs. private schools provides plausible evidence for balance at baseline.

5. Empirical Strategy: Model, Fixed Effects and Clustered Standard Errors

5.1 Model specification and parameters

Even though we ran a randomized control trial, we only have accurate and reliable endline data for analysis. Therefore, our empirical strategy relies on a simple regression. Our model determines the impact of our treatments through an OLS estimation of the dependent variable for those in the AFRIPads (T1), health seminar (T2) and both (T3) groups, when compared to those in the control (C) group.

Ordinary Least Squares (OLS) Model:

$$Y_i = \alpha + \beta_1(Reusable\ Pads_i) + \beta_2(Health\ Seminar_i) + \beta_3(Both_i) + \beta_4(Reusable\ Pads_i\ X\ Government) + \beta_5(Health\ Seminar_i\ X\ Government) + \beta_6(Both_i\ X\ Government) + \gamma X_i' + \varphi_i + \varepsilon$$

Y_i contains information about school absence, wellbeing or test scores. *Reusable Pads, Health Seminar* and *Both* are all indicator (.) variables that adopt the value of 1 if an individual was randomly assigned to receive these treatments. Furthermore, *Government* is also a binary (0/1) variable that adopts the value of 1 if the observation pertains to schoolgirls or mothers associated with enrollment in government schools, respectively. Therefore, β_1 is our causal estimation of the impact of AFRIPads on Y_i, β_2 is the causal estimation of the impact of the health seminar on Y_i, β_3 is the causal estimation of the impact of both these treatments on Y_i, β_4 is the causal estimation of the impact of AFRIPads on Y_i for females in government schools, β_5 is the causal estimator of the impact of our health seminar on Y_i for females in government schools and β_6 is the causal estimation of the impact of both AFRIPads and health seminar on Y_i for females in government schools . Finally, X_i' is a vector of controls: age and income proxy, while φ_i contains our school fixed effect and ε_I is our error term, which is clustered at the level of the classroom.

5.2 Fixed Effects Transformation

As our random assignment takes place within groups / blocks, it is significant to include fixed effects in the model. As we have reason to believe that schools are systemically different from one another, it is necessary for our model specification to capture not only "across-school" but also "within-school" variation. Hence, we rely on:

$$E\ [Y_i \mid T_i, X_i,]$$

where i = 1, 2, 3, 4 based on the school status. Therefore, the fixed effects are applied to Y_i ∋ {School attendance, well-being and test-scores}, T_i ∋ {Reusable pads, Health Seminar and Both} and X_i ∋ {Vector of controls}.

5.3 Clustered Standard Errors

In many RCT(s), it is often standard practice to cluster standard errors at the level of treatment or fixed effects. However, in our experiment this is would lead to too few clusters – as there are only 4 schools in the dataset. Therefore, we decide to cluster standard errors at the classroom level by using the variance-covariance matrix:

$$\Sigma_{cl} = (X' X)^{-1} \{\Sigma X'_g \psi_g X_g\} (X'X)^{-1}$$

We relax the assumptions that errors are not inter-correlated. Thus, as our dataset has a total of 4 schools with 3 grades: (8, 9, 10), and each grade has 3 classrooms – i.e. we have a total of 36 clusters[18].

6. Results: School Absence, Wellbeing and Test Scores

6.1 School Absenteeism

Model (I) in Table 6 of the appendix, presents our results regarding the impact of providing the reusable pads - AFRIPads, health seminar and a combination of both these aforementioned treatments on school absenteeism. We observe that AFRIPads has a statistically significant impact upon absence – there is a total 0.693 schooldays decline in school absenteeism over the span of 5 months that is significant at the 5% level of significance. As the absence is gathered from September 2017 – January 2018, the average decline is 0.138 schooldays per month. On the other hand, while there is no significant decline in school absence based on the provision of health seminars alone, giving schoolgirls, a combination of, both, AFRIPads and Seminar (rather than just one of the two) results in an additional 0.066 schooldays decline in absenteeism on average.

In Figure 6, it can be observed that in the control arm, where no treatment was induced, the average absence of 3.153 school days. In treatment arm I (TI), the average absence is 2.406 school days, which is a decline of 0.693 schooldays, as captured by the impact of AFRIPads alone in Model (I). Next, in treatment arm (II), the average absence is 2.987 schooldays, which is a decline of 0.166 school days, as captured by the impact of Seminars alone in Model (I). Finally, for treatment arm (III), the average school absence is 2.227 school days, which is a decline of 0.926 school days. This is a combination of the impact of AFRIPads alone: 0.693 days + impact of Seminar alone: 0.166 days + impact of their interaction, Both: 0.066 = 0.926 school days. This means a larger decline in school absenteeism is observed in the arm, where we induced both the AFRIPads and the Health Seminar; as the average decline in schooldays missed is 0.185 days per month. This estimate is statistically significant at the 5% level of significance.

[18] (4 schools) X (3 grades in each school) X (3 classrooms in each grade) gives us a total of 4*3*3 clusters = 36 clusters in the dataset.

In Model (II), we include a control that captures our income proxy – i.e. enrollment in a government versus privately-owned school. The impact of AFRIPads is almost consistent with the previous model – as the treatments are orthogonal to potential outcomes, we can observe a decline of 0.682 school days or an average of 0.136 less schooldays missed per month. This estimate is still significant at the 5% level of significance. On the other hand, the impact of receiving a combination of both AFRIPads and the health seminar increases to 0.100 fewer school days of absence. Finally, for the individuals in our dataset, being enrolled in a government-run school is associated with 0.887 days more of absence over 5 months – i.e. on average, government-school girls miss 0.177 days of school more per month than their counterparts in private schools. This positive correlation between our income proxy and absenteeism is statistically significant at the 1% level.

Next, as the menstrual cycle and school attendance, both, have a plausibly strong relationship with age, we include a control for this variable in Model (III). Once again, the impact of the pads remains consistent at a 5% level of significance – we calculate a decline of 0.696 school days in overall absenteeism and an average of 0.139 schooldays per month. Furthermore, the impact of providing both our treatments declines from 0.100 fewer school days to 0.096 fewer school days of absence. Additionally, the influence of our income-proxy remains mostly steady, as schoolgirls from private schools attend 0.901 more schooldays, and on average 0.180 more days of school. Finally, our variable capturing the age of the participants is statistically significant and correlated with school absenteeism at the 1% level of significance – 1-year increments in the age of the schoolgirls leads to 0.376 fewer absent days overall and an average of 0.075 fewer schooldays of absence per month.

Finally, in Model (IV) we explore the heterogeneous outcomes of providing schoolgirls with AFRIPads, health seminar and a combination of both treatments when their impacts are differentiated by our income proxy. First, we account for the impact of providing schoolgirls with AFRIPads, differentiated by our income-proxy. By including an interaction between reusable pads and enrollment in government-run schools, we are able to access whether this treatment heterogeneously benefits girls from government schools, who tend to come from poorer households. The inclusion of variable, *AFRIPadsXGov*, is statistically significant at the 1% level of significance and portrays that for girls in government schools, the provision of reusable menstrual pads causes a decline of 1.147 schooldays of absenteeism. This is an average decline of 0.229 missed schooldays per month. Furthermore, the inclusion of this heterogeneous variable also causes the AFRIPads variable, which now contains the impact of reusable menstrual pads only for girls in private schools, to completely lose statistical significance. This indicates that the impact of AFRIPads on school absence, as seen in Models (I – III), is driven by girls in government schools.

In Figure 7 in the Appendix, we are able to observe the overall decline in school absenteeism over the whole sample of schoolgirls in our dataset. In the control arm (T = 0), girls missed 3.153 schooldays over 5 months and an average of 0.630 school days per month. However, for the girls in treatment arm – T1: AFRIPads, the level of absenteeism was 2.460 days and 0.492 school days per month. Next, in Figure 8 of the appendix, when we further distribute this impact between girls in government schools (Gov = 1) and girls in private schools (Gov = 0). The impact of AFRIPads on absenteeism exists solely for girls enrolled in government schools: Based on our income proxy, for schoolgirls in private schools (Gov = 0) the decline in missed schooldays is 2.384 – 2.230 = 0.154 schooldays. On the other hand, for girls from government schools (Gov = 1) the decline in missed days of school is 3.923 – 2.675 = 1.136 school days – i.e. on average, a decline of 0.227 school days less per month.

Next, we also sought to separate the impact of our health seminars, at a level differentiated by our income proxy. In Model (IV), we also introduce a variable capturing the interaction between being enrolled in a government schools and participating in our health seminar. While the impact of all other variables remains mostly consistent, the effect of providing health seminar only on overall absenteeism, as captured by our Seminar variable, declines from 0.159 school days to 0.080 school days. This effect can be observed in Figure 9 of the appendix. On the other hand, while we find that our interaction term, *SeminarXGov*, indicates an impact of 0.151 fewer absent days, neither the seminar nor its interaction with our income proxy, are statistically significant. This shows that our health seminars are not effective in closing the attendance gap for females – neither homogeneously, nor heterogeneously. This can be seen in Figure 10 of the Appendix, where we observe no impact of health seminars for private or government schoolgirls.

Finally, we isolate the additional impact of providing schoolgirls with a combination of both, AFRIPads and health seminar, differentiated by our income proxy. We include an interaction variable, *BothXGov*, in order to generate this subset of the data pool. It can be observed that for this group of schoolgirls, there is an additional decline of 0.081 schooldays, which is statistically significant at the 5% level of significance. In Figure 11, we can first observe the impact of, both, AFRIPads and the health seminar on overall absenteeism – i.e. upon all schoolgirls in the dataset. The graph shows a decline of 0.926 schooldays missed by those enrolled in our combination treatment versus those in the control. This is an average of 0.185 fewer days of absence per month.

However, just like the impact of AFRIPads alone, in Figure 12, we are able to notice that the impact of a combination of our treatments is driven by girls in government schools. Based on our income proxy, the decline in school absenteeism for girls in private schools (Gov = 0) is 2.384 – 2.131 = 0.253 schools, which is an average of 0.050 school days per

month. On the other hand, for girls in government schools (Gov = 1), the decline in school absenteeism caused by both treatments is 3.923 – 2.317 = 1.606 fewer missed schooldays. Therefore, this is the largest heterogeneous decline in absence caused by our treatments. This indicates that not only do girls in government schools benefit heterogeneously from the provision of menstrual resources, they also benefit the most from a combination of physical resources like AFRIPads and structural resources like health seminars.

Finally, in Figure 13 we provide an overall look at the endline levels of absenteeism across treatment arms, as categorized by our income proxy. First, we observe that almost all treatment arms for private schools (Gov = 0) have similar level of absenteeism on average – including the control arm. As predicted by models in Table 6 of the appendix, this is because we are unable to find any significant impact of our treatments upon absenteeism for girls enrolled in private schools. Consequently, if there was no impact on private schoolgirls' absenteeism post-treatment, then then level of absenteeism across all arms in the figure are reasonably representative of near pre-treatment levels absenteeism. Hence, the consistency across all treatment arms for private schoolgirls also provides plausible evidence that, at baseline, all four arms were systemically similar.

6.2 Test Scores

Table 7 in the Appendix provides the results concerning the effect of our treatment upon the test scores of our participants. Consistently from Models (I) – Models (VII), we are unable to find any statistically significant impact of any treatment on the test scores for the schoolgirls in our dataset. Furthermore, the only significant associations of test scores are seen with age and enrollment in a government versus private school. On average, a 1-year increment increase in the age of the participant is associated with a 1.470% decline in test scores cumulatively. On the other hand, girls who attend government schools tend to score, on average, 5.615% less on tests than their counterparts in private schools. Figures 14 – 19 in the appendix illustrate our null results regarding grades.

On the other hand, Figure 20 in the appendix, illustrates a comprehensive look at the endline test scores across treatment arms, as categorized by our income proxy. As we were unable to detect any impact of any of our treatments on test scores, we do not observe much variation between the average test scores between our control and treatment arms – not even heterogeneously. Therefore, the levels of grades in the 3 treatment arms, which are plausibly similar to the control arm, must also be plausibly similar to their initial levels, pre-treatment. Therefore, the consistent level of test scores across the treatment and control arms, in both private and government schools, provide further justification that our arms were systemically similar in composition at baseline and hence, are eligible for identification of impact.

6.3 Wellbeing

6.3.1 Daughters

Table 8 in the appendix presents our results concerning the impact of our treatment upon the social and psychological wellbeing of the daughters in our dataset. In Model (I) we capture the impact of AFRIPads, health seminar and a combination of both treatments over all daughters in our dataset. We find no impact of the reusable menstrual pads on the girls' social and psychological wellbeing. On the other hand, we do find a significant impact of our health seminar. We observe that schoolgirls who participated in our seminar, showed a 0.666 units increase in their average wellbeing. This estimation is statistically significant at the 1% level of significance. Furthermore, there is an additional 0.066-unit additional impact of providing a combination of our treatments to the subjects.

In Figure 21, in the appendix, we can see that the increase in daughters' wellbeing caused by AFRIPads is negligible: 2.282 – 2.205 = 0.078, as captured by the AFRIPads variable alone in Model (I). It can also be seen that the health seminars create a 2.871 – 2.205 = 0.666 units increase in the subjects' wellbeing, as captured by the Seminar variable alone in Model (I). Finally, the largest increase is documented when a combination of the treatments is induced, as wellbeing increases by 3.0177 – 2.205 = 0.812 units. This is a combination of the impact of AFRIPads alone: 0.078 + Seminar alone: 0.666 + Both: 0.066 (as seen in Model II of Table 8) = 0.812-unit increase.

Next, similar to previous tables, in Model (III) we control for our income proxy – i.e. whether the individual attends a private versus a government school. Unlike absence or test scores, we are unable to find any impact of our income proxy differentiation on the social and psychological wellbeing of the schoolgirls. Furthermore, when we control for the age of the participant, we find that age has an inversely proportional relationship with the wellbeing of daughters. An increment of 1-year in the age of the schoolgirl is associated with a 0.113-unit decline on our wellbeing index. This impact is statistically significant at the 1% level of significance. Finally, in Model IV we begin determine whether there exists any heterogeneous impact of our treatments on the wellbeing of daughters. Unfortunately, we are unable to detect any heterogeneity of this nature. Our interaction variables which combine the impact of AFRIPads on government schoolgirls – *AFRIPadsXGov*, the impact of health seminar on government schoolgirls – *SeminarXGov*, and a combination of both on government school – *BothXGov,* are all statistically insignificant. This can be observed in Figures: 22 – 27.
In fact, the only statistically significant impact, at the 1% level of significance, is that of the health seminar alone, which indicates a 0.665-unit increase in wellbeing in Model IV. This indicates that, unlike absenteeism, there does not exist any treatment heterogeneity in the impact of the health seminar.

This can be observed in Figures 24 and 25, where both, overall and distributed impact of the health seminars exist when income proxy (Gov) = 1 and when income proxy (Gov) = 0 respectively. In addition to this, we can observe that providing a combination of, both, AFRIPads and health seminars to schoolgirls in government schools results in an additional 0.052-unit increase in their wellbeing, while providing this combination to private schoolgirls results in an additional increase in their wellbeing by 0.041 units. This has been illustrated in Figures 26 and 27, where we can observe the largest increase in wellbeing for daughters. Finally, Figure 28 offers an overview about the wellbeing of daughters across all treatment arms, as categorized by our income proxy. One again, as predicted by the model, there is no significant differences between the wellbeing of daughters in the control arm and those in the T1: AFRIPads arm. However, we are able to notice significant gains in wellbeing for those subjects in T2: health seminar and T3: both (a combination of AFRIPads and health seminar).

6.3.2 Mothers

We ran different regressions for wellbeing for mothers vs. daughters. This was a measure of control regarding the standard errors in our estimates, as we believe that mothers and daughters prioritize different needs during their menstruation. Table 9 provides our results regarding the impact of AFRIPads, health seminars and, both, AFRIPads and health seminars on the wellbeing of the mothers in our sample. From Model (I) – Model (IV) we find no indication that any of our treatments had any statistically significant impact upon the emotional wellbeing of our mothers. The only statistically significant correlation exists with age for this subject pool. Unlike the daughters in our dataset, an increase in age for the mothers is strongly associated with an average of 0.072 units increase in emotional wellbeing in Model (III) and an average of 0.077 units increase in Model (IV). This estimated correlation is significant at the 1% level of significance

Figure 29 provides the overall impact of all treatments upon mothers, differentiated by the income proxy. As outlined by the Models in Table 9, there is no visible and significant impact of any treatment arm for mothers' wellbeing, when compared to the respective controls in our study. Hence, once again, we have reason to believe that these levels of wellbeing in treatments arms I, II and III that are very similar to their control groups c (with respect to the income proxy category), and are justifiably similar to their pre-treatment levels. Therefore, the consistency across all treatment arms, regarding the wellbeing of the subjects in our dataset, provides further plausible evidence that at baseline all arms were balanced and systemically similar to one another. Thus, impacts can be justifiably identified in this research.

7. Discussion: Potential Biases, Limitations and Future Proposals

7.1 Potential Biases and Limitations

7.1.1 Biases that threaten internal validity

Once again, the most important bias in this study is our lack of reliable baseline data. According to the principles of randomization, it should be enough to simply compare then outcome of the treatment arms to the outcome of the control arm at endline. However, this is often not realistic in practice (Kendall, 2003). While the average level of the variables of interest like absenteeism, test scores and wellbeing are observable at endline, it is possible that these levels were initially unequal or may have been altered by an external factor.

Therefore, we demonstrate balance in the summary statistics with all possible confounding / time-invariant factors available in the dataset: age, ethnicity, religion, marital status, income, days into the menstrual cycle etc. We also utilize the data on our dependent variables, which have not been affected by our treatments, to show that their levels at endline are systemically similar to the control and, therefore, pre-treatment. Nonetheless, these are simply plausible evidence and the bias against identification must be acknowledged.

Furthermore, in our research design, we chose to block randomize – i.e. we randomly assigned subjects to the treatment and control arms from within each 'blocks': schools. Thus, there is a high probability of spillovers between the treatment and control groups (Wooldridge, 2016). However, in our study we have no reason to assume that any spillover from the treatment arms could have negative impacts on the subjects in the control group[19]. But since we do not have a pure control group, it is impossible for us to assign absolute certainty or numerical value to the event of a positive spillover.

7.1.2 Limitations to external validity

In the research design, we randomly selected four schools from a list of schools located in the Far Western Development Region of Nepal within the Kailali district. This is because the Far Western Region of Nepal is an area of high problem prevalence – i.e. there is high levels of female absenteeism in secondary school, coupled with poverty and menstrual stigmatization. Nonetheless, our results are still only generalizable to the population within this district. Due to a combination of the location and the subject-pool, which was highly targeted in nature and included systematically different girls from, both, private and government schools, we were able to, not only causally identify impacts, but also able to identify the heterogeneous impact of our treatment variables. This indicates a trade-off between accuracy and generalizability.

[19] This statement is at the researcher's discretion. We find no plausible explanation for a negative spillover.

7.2 Future Proposals

One of the main extensions of our study deals with the long-term impact of AFRIPads and the health seminars on absenteeism, test scores and wellbeing. We would like to observe whether the impacts estimated sustain themselves over time or are merely a temporary reaction to the treatments induced by us. Another fascinating addition to this study would be to incorporate a higher number of subjects and include an additional treatment arm. We could provide subjects with a resource that is not related to menstruation. Thus, we can identify whether the problem and solution are truly related to periods or are driven by the fulfillment of a resource scarcity.

8. Conclusion

8.1. Summary and Discussion of Results

In our experiment, we provided 312 schoolgirls and 100 of their mothers with reusable menstrual pads (AFRIPads) and / or informative health seminars in the Far Western Development Region of Nepal. In doing so, we find that there is a significant negative impact of providing schoolgirls with AFRIPads on absenteeism. We find a decline of 0.693 school days per 5 months, which is significant at the 5% level of significance. On the other hand, while we find no influence of our health seminars alone on school absenteeism, we also find that the largest decline in absence occurs for girls who were provided both the reusable pads and the health seminars – school absence decreases by 0.926 school days per 5 months, and is statistically significant at the 5% level of significance.

Furthermore, as our dataset contains two types of schools (private versus government owned that are systemically different from one another), we are able to identify the heterogeneous treatment effect of our intervention variables. In Nepal, the government subsidizes schooling until Grade 10. Therefore, girls who attend government schools often come from poorer households or are also often from marginalized backgrounds. On the other hand, girls who attend private schools are wealthier and tend to have more educated parents. Thus, because such systemic differences exist among subsets of the subject-pool, we have reason to believe that our treatments will have different outcomes across these subsets. Thus, we utilize enrollment in government-run schools as an income proxy, and categorize the girls into low-income (1) and high-income category (0).

Once we control for this heterogeneity, we find that there is no impact of any treatment upon private schoolgirls' absenteeism. On the contrary, for girls in government schools, there is a statistically significant impact of reusable pads – it decreases absenteeism by 1.147 schooldays per 5 months, while inducing both treatments declines school absence by 1.379 days per 5 months. Furthermore, we also see that simply being enrolled in a

government-run school is associated with almost 1 and half more days of school absence, when compared to their counterparts attending private schools. Perhaps, the introduction of our treatment variables are addressing this correlation. By providing either a physical resource that is essential yet expensive, as well as spreading awareness about the role of menstruation, we seem to be bridging some of the gap that exists between the school days attended by girls in private versus government schools. In government schools, where subjects have lower household income, education and social standing, the reusable pads seem to be disproportionately helpful in creating the ability to attend more schooldays.

Unfortunately, we are unable to capture any significant impact of our treatments on test scores. However, we do find that enrollment in a government school to be strongly correlated with lower test scores – on average, girls in government schools attain almost 5.5% less on their cumulative examinations, when compared to their counterparts in private schools. Because we are not able to causally attribute this impact, we can simply infer that while test scores are generally noisy (as they are function of multiple endogenous inputs), the level of discrepancy that exists between the scores for girls in private versus government schools contains a strong correlative story.

However, none of our treatment variables are able to bridge this gap. We have multiple theories for this outcome: it is possible that our study was conducted over a very short time-span, and therefore, we are unable to pick up such long-term outcomes. The time elapsed between the baseline and endline was 6 months – which is equal to 1 exam between the two time periods for the girls. It seems difficult to be able to find an impact on test scores within such circumstances. Another plausible reason for this outcome deals with the existing state of schools within the Far Western Development Region in Nepal. Teacher absenteeism is also a significant challenge to education in this part of the country. If our treatments are able to drive certain schoolgirls to attend more school, but the benefits from attending school are differentiated through challenges other than simply attendance then it becomes difficult to find any impact on test scores.

On the other hand, we find much more optimistic results with respect to schoolgirls' well-being. First, we find no impact of reusable pads on wellbeing for girls in government-run or privately-owned schools. However, our health seminar seems to increase outcomes on our health index by 0.666 units for daughters overall. This estimate is statistically significant at the 1% level of significance. Furthermore, this impact exists homogenously for girls in, both, government and private schools. Therefore, we might infer that while the challenge posed by the resource burden of menstruation is a function of income, the challenge posed by the stigmatization of menstruation is a function of culture. Hence, the impact of our health seminar is not heterogeneous based on our income proxy.

Finally, we are unable to estimate any impact of any reusable pads or health seminars on the wellbeing of mothers. While daughters seem to be extremely prone to changes in information and awareness, mothers do not display a similarly, statistically significant increase in social and psychological outcomes. Thus, we conclude that there exists some discrepancy in the ability to influence beliefs and perceptions that is correlated with age and time. Even though mothers and daughters come from the same household, the health seminars benefit only the daughters. This result can be attributed to the way long-term beliefs and perceptions manifest over time (Dresden, 2005). Conversely, we also had fewer mothers (N = 100) in total that received the treatments. Therefore, it is also possible that our sample size is too small to pick up any significant changes due to the low power of our study – especially as this subject pool is further divided up by treatment arms.

8.2. Policy Recommendations

The challenges surrounding menstruation in developing countries are complex. They can stem from simple resource scarcity in low-income communities for females living with multiple other females in a household – menstrual resources are a recurring cost. However, they are also equally rooted in culture, tradition, religion, gender roles, norms and identity. Therefore, policies and interventions must also be multidimensional in nature. From our study, we are able to find a statistically significant impact of providing females with reusable menstrual pads and / or health seminars. We also observe that absenteeism decreases, while wellbeing increases for a subset of our subject-pool in the dataset, respectively. Thus, through our paper we would like to focus on two major outcomes that can help the construction of policy and future funding into menstrual research.

8.2.1. Resource Subsidization

First, we find that when we provide girls with AFRIPads – i.e. we subsidize the cost of menstrual products and therefore lessen the resource burden surrounding periods, a certain subset of girls (i.e. those enrolled in government schools) increases their school attendance. However, they show no such improvements on our wellbeing index due to these reusable pads. In fact, it requires the introduction of health seminars to be able to observe such an improvement. This indicates that for challenges like those surrounding periods in Nepal, which is deeply embedded in social and cultural factors, simply subsidizing or providing a resource, while extremely important for certain subsets of the subject-pool, may not be sufficient to empower females. Thus, policies must also incorporate social and structural support systems that can complement such physical resources.

8.2.2. Treatment Heterogeneity

Second, related to this outcome is the idea of treatment heterogeneity. Our results show that girls from low income households benefit disproportionately from the provision of resources, while younger subjects – i.e. daughters also benefit disproportionately from the provision of information and awareness. Hence, we are able identify the crucial structures that drive results surrounding our variables of interest, with regards to menstruation. Therefore, as a policy outcome, we reiterate the ideas presented in the normative review – i.e. there exists systematic differences between subsets of our subject-pool, even if they seem homogenous with respect to eligibility into treatment. Such differences, drive the outcomes of policies and interventions aimed that addressing menstrual challenges. Therefore, social, cultural, local and subjective knowledge about subjects is crucial to identifying impacts of menstruation related interventions.

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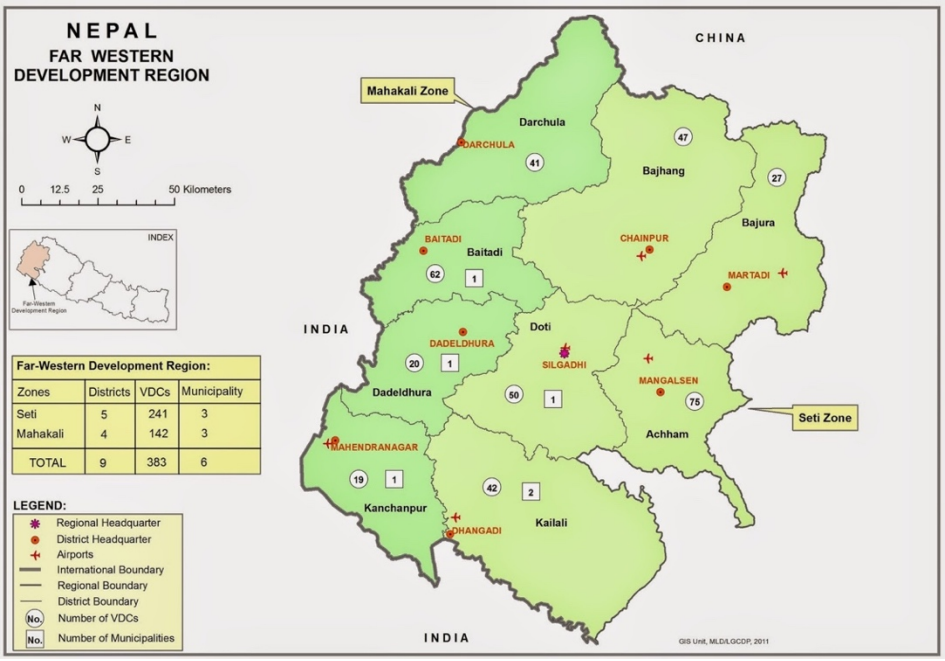
Appendix

Figure 1: The Far-Western Development Region (*Sudhur Paschimanchal Bikas Kshetra)*



Source: https://beautifulfarwestnepal.blogspot.com/2015/04/map-of-far-western-development-region.html

Figure 2: The organization of the blocked-randomization

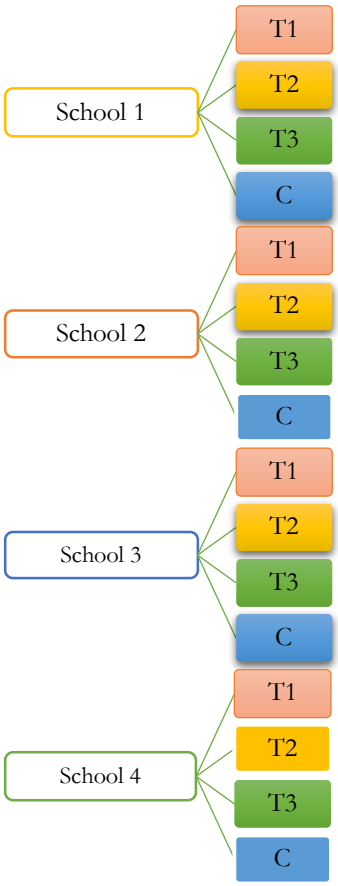


Table 1: The number of subject balanced among treatment and control groups

	T1	T2	T3	C
School 1	26	27	26	27
School 2	25	26	26	27
School 3	26	27	25	25
School 4	24	25	27	24
Total	101	105	104	102

Table 2: The number of mothers and daughters balanced among treatment and control arms

	T1	T2	T3	C
Mothers	25	26	25	24
Daughters	76	79	79	78
Total	101	105	104	102

Table 3: The treatment matrix

		Health Seminar	
		Yes	**No**
AFRIPads	**Yes**	T3	T1
	No	T2	C

Figure: 3 The general process of utilizing an AFRIPad kit *[Source: AFRIPads]*

Figure 4: The self-reported cost of menstrual resources for the females in our dataset at endline

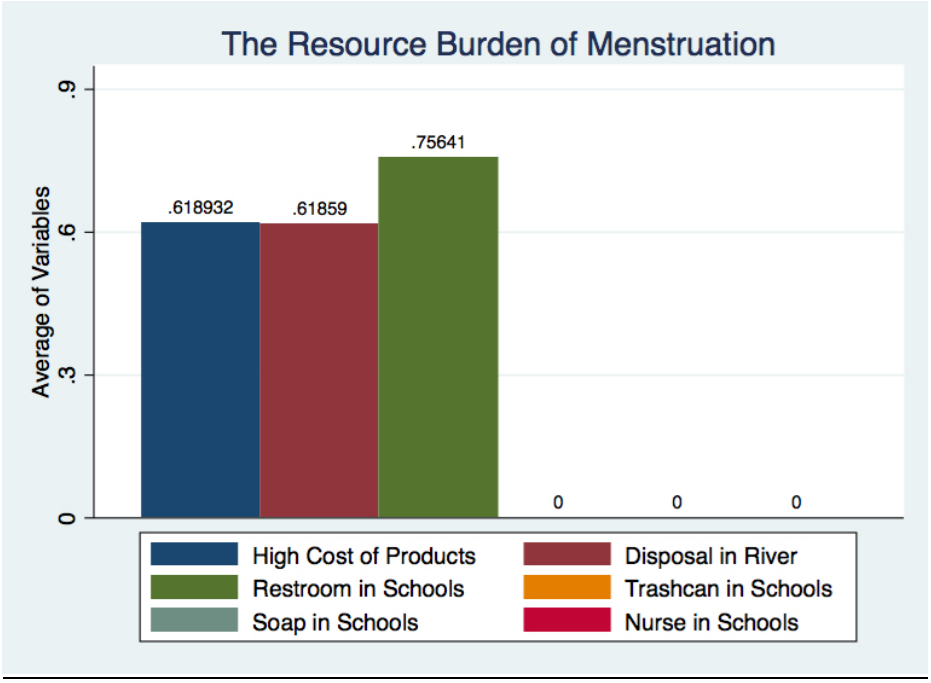


Figure 5: The self-reported social and psychological impact of menstruation at endline

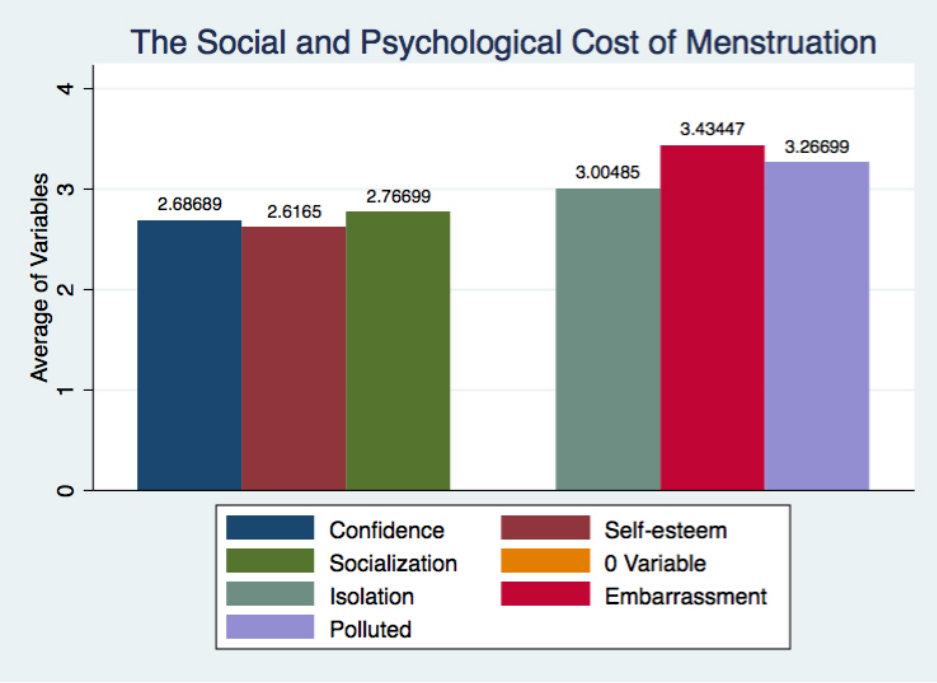


Table 4: Social and psychological questions that comprise of the wellbeing index

1	On a scale of 1-5, how confident are you during your periods?
2	On a scale of 1-5, how would you rate your self-esteem during your periods?
3	On a scale of 1-5, how social are you during your periods?
4	On a scale of 1-5, how isolated do you feel during your periods?
5	On a scale of 1-5, how embarrassed are you during your periods?
6	On a scale of 1-5, how polluted do you feel during your periods?

Table 5: Summary Statistics

	T1	T2	T3	T4
		Age		
Mothers	37.800	37.692	37.880	37.708
	(4.291)	(4.434)	(4.475)	(4.408)
Daughters	14.539	14.582	14.556	14.576
	(2.042)	(2.115)	(1.972)	(2.129)
		Product usage: Cloth		
Mothers	0.720	0.769	0.760	0.750
	(72%)	(76.9%)	(76%)	(75%)
Daughters	0.605	0.582	0.607	0.602
	(60.5%)	(58.8%)	(60.7%)	(60.2%)
		Product usage: Cloth by income proxy		
Private Schools	0.549	0.566	0.607	0.568
	(54.9%)	(56.6%)	(60.7%)	(56.8%)
Government	0.720	0.692	0.679	0.705
Schools	(72.0%)	(69.2%)	(67.9%)	(70.5%)
		Income Proxy (Gov = 1)		
Mothers	0.520	0.500	0.480	0.500
	(52%)	(50%)	(48%)	(50%)
Daughters	0.486	0.493	0.518	0.500
	(48.6%)	(49.3%)	(51.8%)	(50%)
		Days into Menstrual Cycle		
Mothers	14.400	14.538	14.458	14.291
	(8.416)	(7.489)	(7.773)	(8.853)
Daughters	14.413	14.316	14.012	14.064
	(7.863)	(7.277)	(7.303)	(6.906)
		Marital Status		
Mothers	1.24	1.000	1.120	1.000
	(.830)	(0.000)	(0.600)	(0.000)
Daughters	2.039	2.012	2.000	2.000
	(0.196)	(0.112)	(0.000)	(0.000)
		Hindu-head of Household		
Private Schools	0.983	0.924	0.924	0.980
	(0.140)	(0.266)	(0.140)	(0.140)
Government Schools	0.980	0.980	0.980	0.980
	(0.141)	(0.138)	(0.192)	(0.140)
		Ethnicity		
Magar	45.000	51.000	49.000	50.000
	(10.920%)	(12.378%)	(11.893%)	(12.135%)
Chettri	20.000	19.000	19.000	16.000
	(4.854%)	(4.611%)	(4.611%)	(3.883%)
Brahmin	15.000	16.000	12.000	18.000
	(3.640%)	(3.883%)	(2.912%)	(4.368%)
Gurung	11.000	10.000	12.000	10.000
	(2.669%)	(2.427%)	(2.912%)	(2.427%)
Tharu	10.000	8.000	12.000	8.000
	(2.727%)	(1.941%)	(2.912%)	(1.941%)
N	101	105	104	102

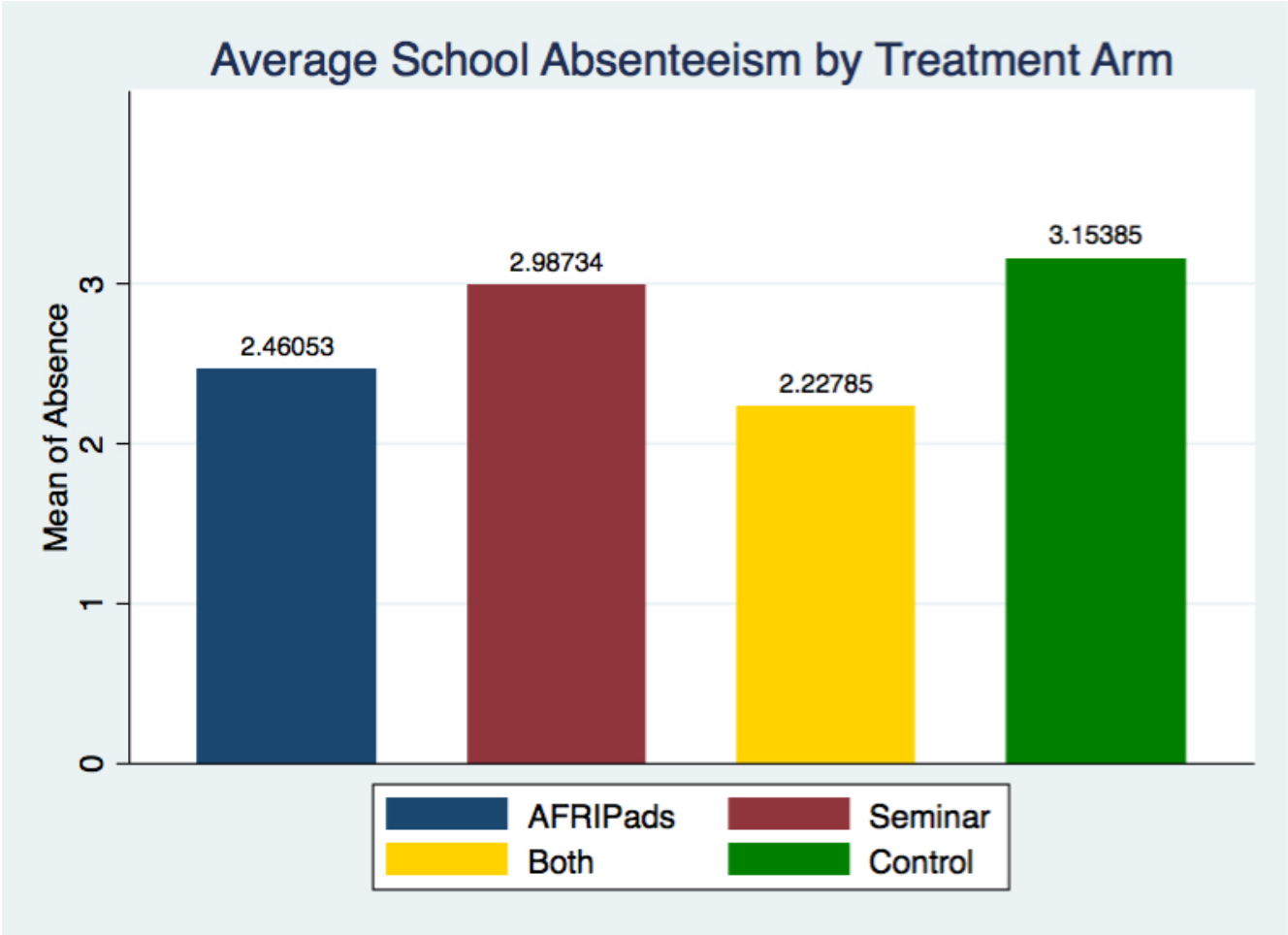
Table 6: Impact of All Treatments on School Absenteeism

	Model (II) Absence	Model (II) Absence	Model (III) Absence	Model (IV) Absence
AFRIPads	-0.693**	-0.682**	-0.696**	-0.128
	(0.242)	(0.230)	(0.212)	(0.215)
Seminar	-0.167	-0.161	-0.159	-0.080
	(0.219)	(0.213)	(0.172)	(0.223)
Both (AFRIPads & Seminar)	-0.066	-0.100	-0.096	-0.039
	(0.313)	(0.292)	(0.270)	(0.362)
Government School *(Income Proxy)*		0.887***	0.901***	1.568***
		(0.308)	(0.173)	(0.291)
Age			-0.376***	-0.378***
			(0.040)	(0.041)
AFRIPads X Gov *(Heterogeneous Variable: I)*				-1.147**
				(0.380)
Seminar X Gov *(Heterogeneous Variable: II)*				-0.151
				(0.344)
Both X Gov *(Heterogeneous Variable: III)*				-0.081
				(0.545)
Constant	3.154***	2.711***	8.191***	7.875***
	(0.272)	(0.311)	(0.574)	(0.665)
R-squared	0.060	0.143	0.396	0.434
N	312	312	312	312

Standard errors reported in parentheses. * significant at 10% **significant at 5% ***significant at 1%

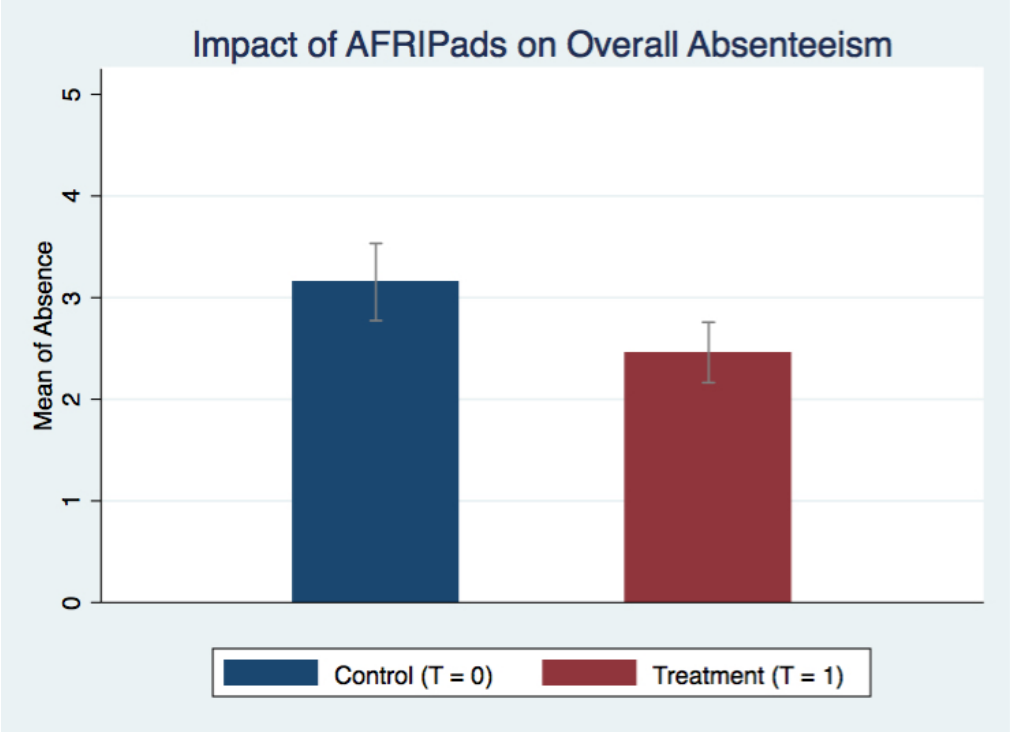
This table reports the impact of AFRIPads, health seminar and both of these treatments on school absence (in comparison to the respective control groups). Here, the measure of absence is the overall absence recorded in the school registers for each individual in the dataset. Models (I) and (II) access the impact of AFRIPads, Health seminar and both treatments on absence respectively. Models (III) and (IV) demonstrate the impact of the aforementioned treatments but with the addition of control variables like enrollment in government-run schools or age. Models (V), (VI) and (VIII) capture the impact of aforementioned treatments along with the interaction variable – i.e. the heterogeneous impact of AFRIPads, Seminar and, both, AFRIPads and Seminar upon the absence of government school girls.

Figure 6: The levels of absenteeism categorized by each treatment arm at endline



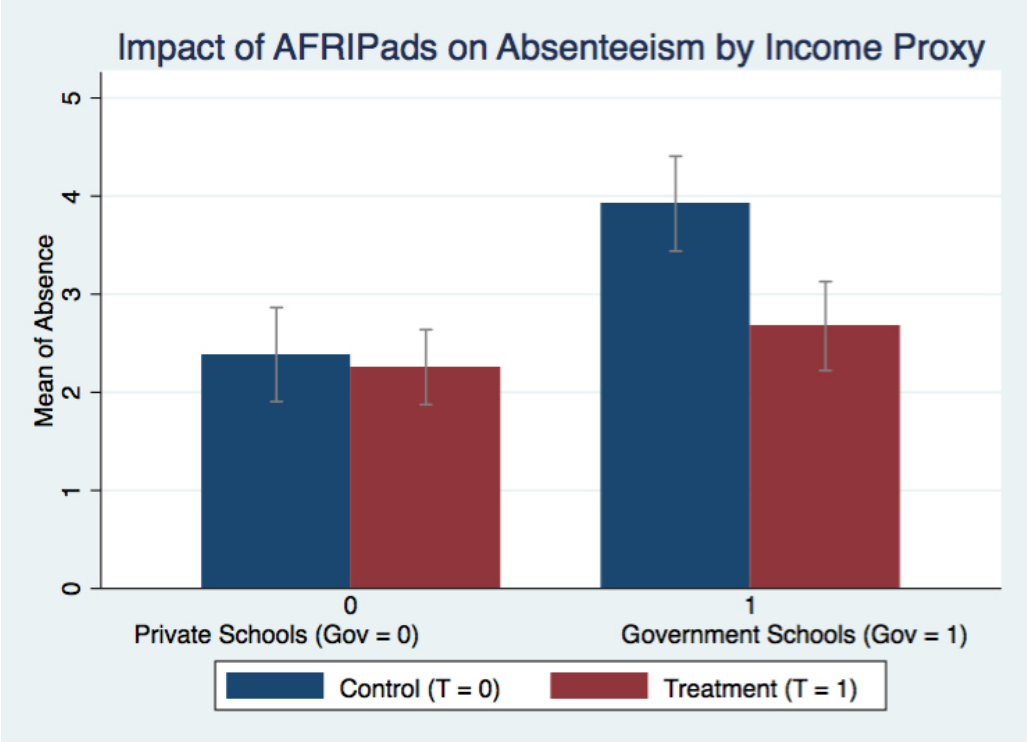
*****One of the major challenges of this research is our lack of access to baseline data. The closest analysis we can present is the plausible balance of time-invariant variables in the summary statistics table. They provide substantial reason to believe that at baseline, all four arms (T1: AFRIPads, T2: Health Seminar, T3: Both and C: Control) were systemically similar to one another and therefore are akin the control group at post-treatment – i.e. they are comparable for analysis. Thus, we will utilize the level of absenteeism seen in control (C) in this Figure 6 as an estimation of what pre-treatment absence levels were like for all groups and comparison of means will take place between the control group and the rest of the groups in this figure.*****

Figure 7: Impact of AFRIPads on overall absenteeism between control and treatment



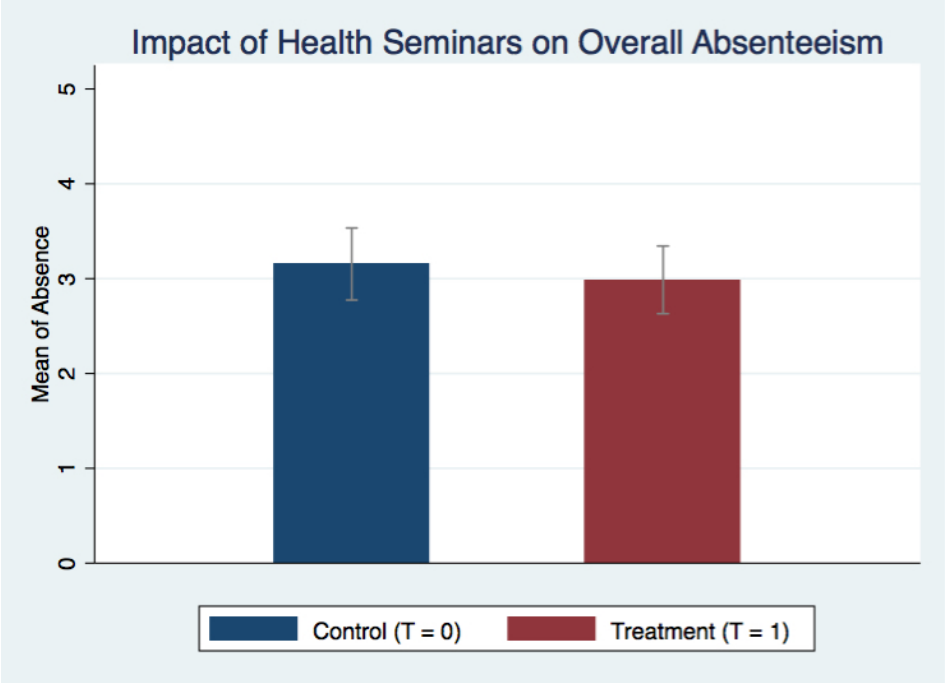
***** Bars denote standard errors*****
Significant decline in absenteeism for groups that received AFRIPADs versus the control.

Figure 8: Impact of AFRIPads on absenteeism between control and treatment categorized by income proxy / government school enrollment (Gov = 1)



***** Bars denote standard errors*****
Significant decline in absenteeism for groups that received AFRIPads versus the control, driven by subset of population enrolled in government schools.

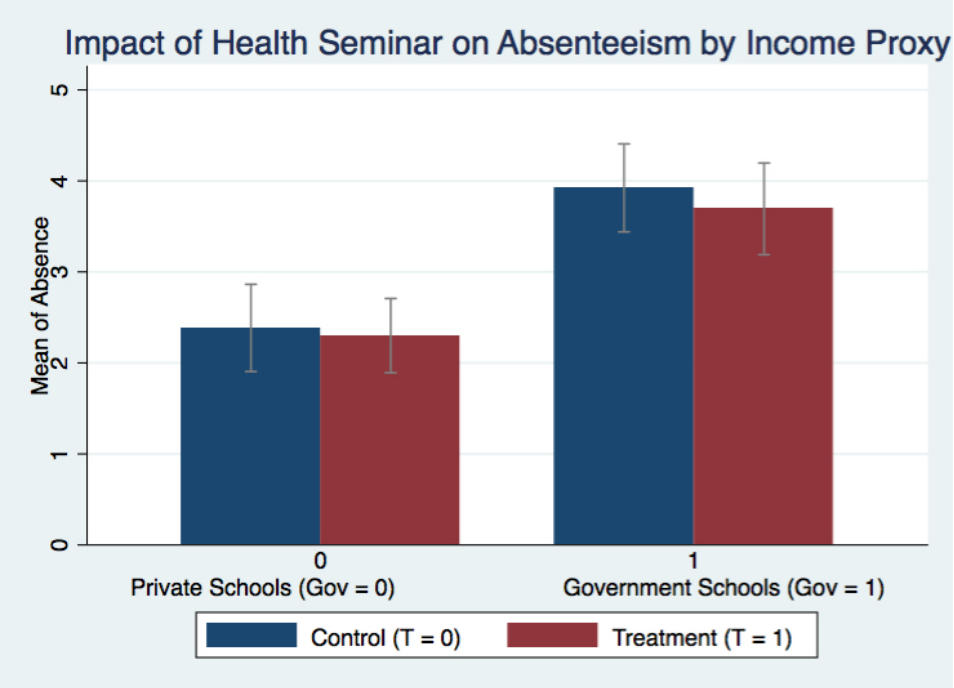
Figure: 9 Impact of health seminars on overall absenteeism between control and treatment



***** Bars denote standard errors*****

No significant decline in absenteeism for groups that received health seminar versus the control group.

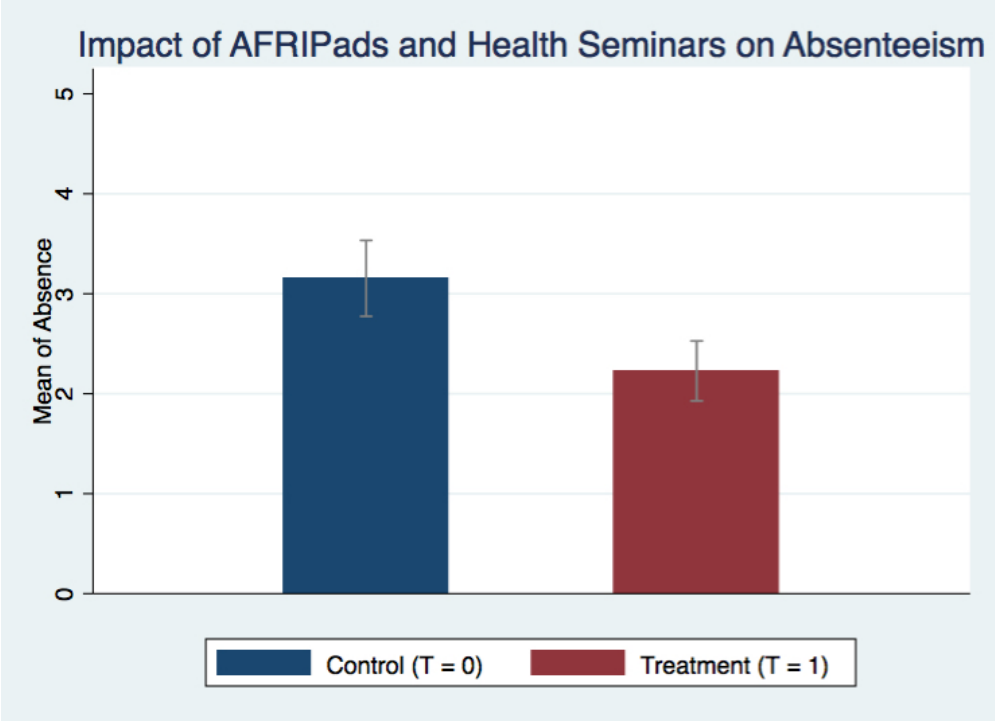
Figure: 10 Impact of health seminars on absenteeism between control and treatment categorized by income proxy / government school enrollment (Gov = 1)



***** Bars denote standard errors*****

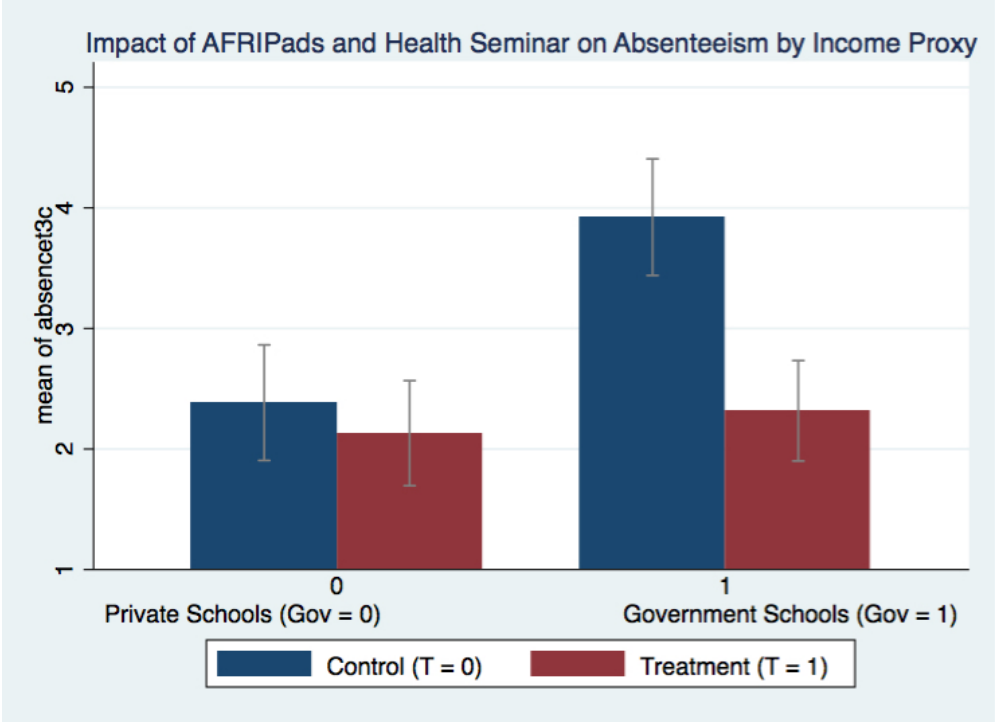
***** No significant decline in absenteeism for groups that received health seminar versus the control group, driven by subset of population enrolled in government schools.

Figure 11: Impact of, both, AFRIPads and health seminar on overall absenteeism between control and treatment



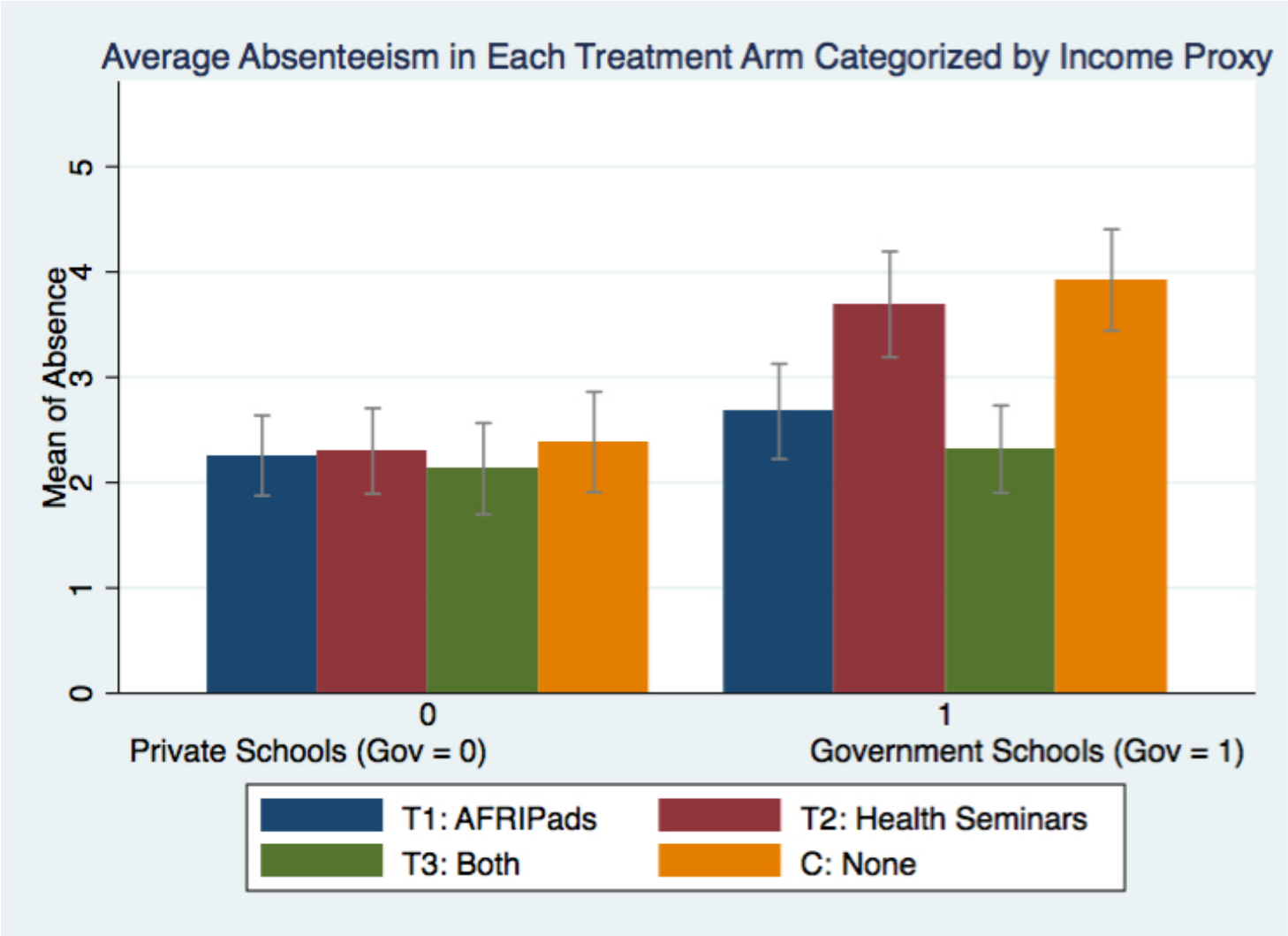
***** Bars denote standard errors*****
Significant decline in absenteeism for groups that received AFRIPADs and health seminar versus the control.

Figure 12: Impact of, both, AFRIPads and health seminar on overall absenteeism between control and treatment categorized by income proxy / government school enrollment (Gov = 1)



***** Bars denote standard errors*****
Significant decline in absenteeism for groups that received AFRIPads and health seminar versus the control, driven by subset of population enrolled in government schools.

Figure: 13 Impact of all treatments on absenteeism between control and treatment categorized by income proxy / government school enrollment (Gov = 1) at endline



***** Bars denote standard errors*****

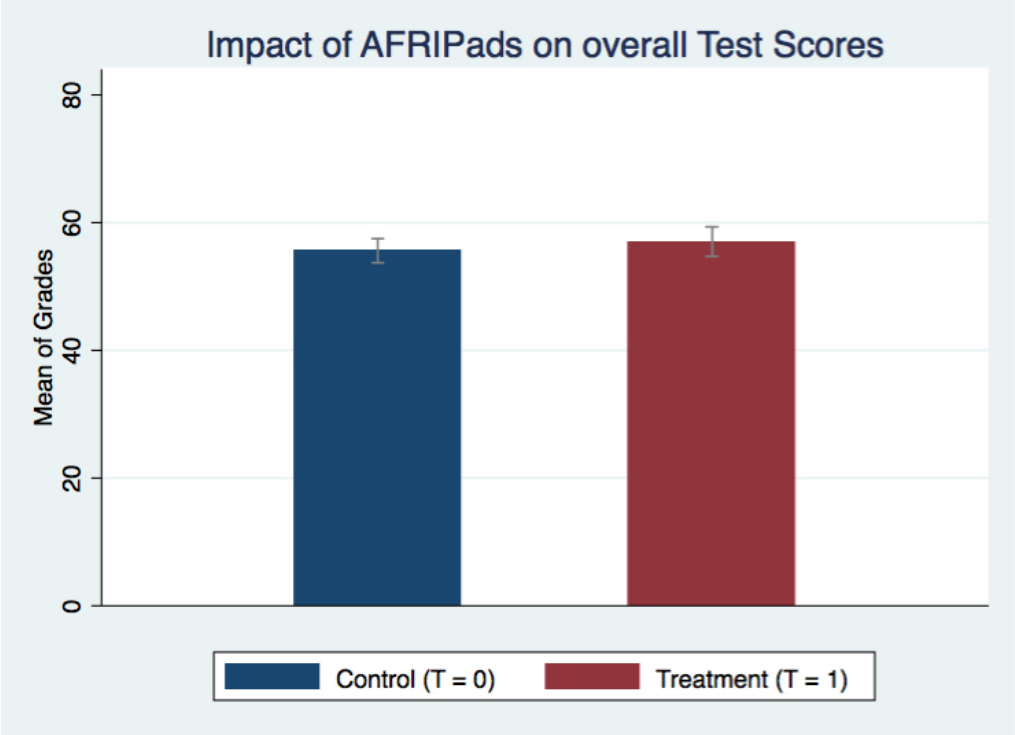
Table 7: Impact of All Treatments on Test Scores

	Model (I) Test Scores	Model (II) Test Scores	Model (III) Test Scores	Model (IV) Test Scores
AFRIPads	1.424 (1.243)	1.352 (1.214)	1.298 (1.249)	1.154 (1.814)
Seminar	1.170 (1.432)	1.135 (1.376)	1.144 (1.440)	1.029 (2.500)
Both **(AFRIPads & Seminar)**	0.842 (2.003)	1.050 (2.009)	1.066 (2.062)	0.774 (3.507)
Government School ***(Income Proxy)***		-5.415*** (1.437)	-5.359*** (1.033)	-5.759*** (1.687)
Age			-1.471*** (0.273)	-1.470*** (0.274)
AFRIPads X Gov ***(Heterogeneous Variable: I)***				0.286 (2.497)
Seminar X Gov ***(Heterogeneous Variable: II)***				0.228 (2.875)
Both X Gov ***(Heterogeneous Variable: III)***				0.564 (4.171)
Constant	55.603*** (1.280)	58.310*** (1.431)	79.719*** (4.539)	79.911*** (4.770)
R-squared	0.015	0.086	0.1748	0.1752
N	312	312	312	312

Standard errors reported in parentheses. * significant at 10% **significant at 5% ***significant at 1%

This table reports the impact of AFRIPads, health seminar and both of these treatments on test scores (in comparison to the respective control groups). Here, the measure of test scores is the last cumulative test taken by all schoolgirls. Models (I) and (II) access the impact of AFRIPads, Health seminar and both treatments on absence respectively. Models (III) and (IV) demonstrate the impact of the aforementioned treatments but with the addition of control variables like enrollment in government-run schools or age. Models (V), (VI) and (VIII) capture the impact of aforementioned treatments along with the interaction variable – i.e. the heterogeneous impact of AFRIPads, Seminar and, both, AFRIPads and Seminar upon the absence of government school girls.

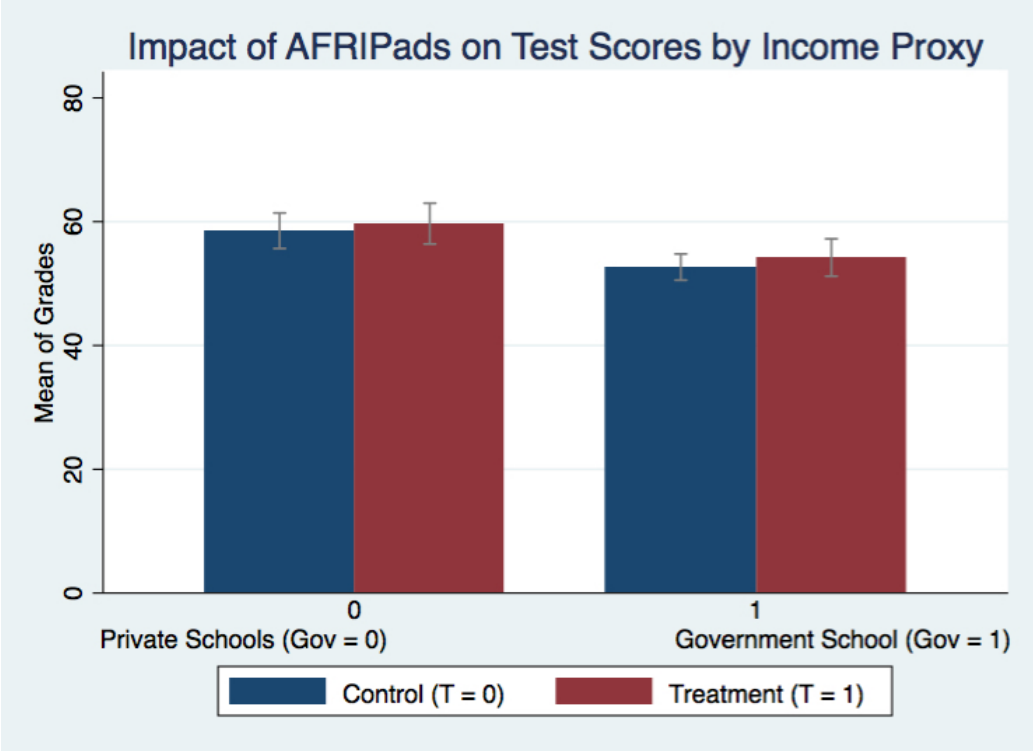
Figure 14: Impact of AFRIPads on overall test scores between control and treatment



***** Bars denote standard errors*****

***** No significant change in test scores for groups that received AFRIPads versus the control group.

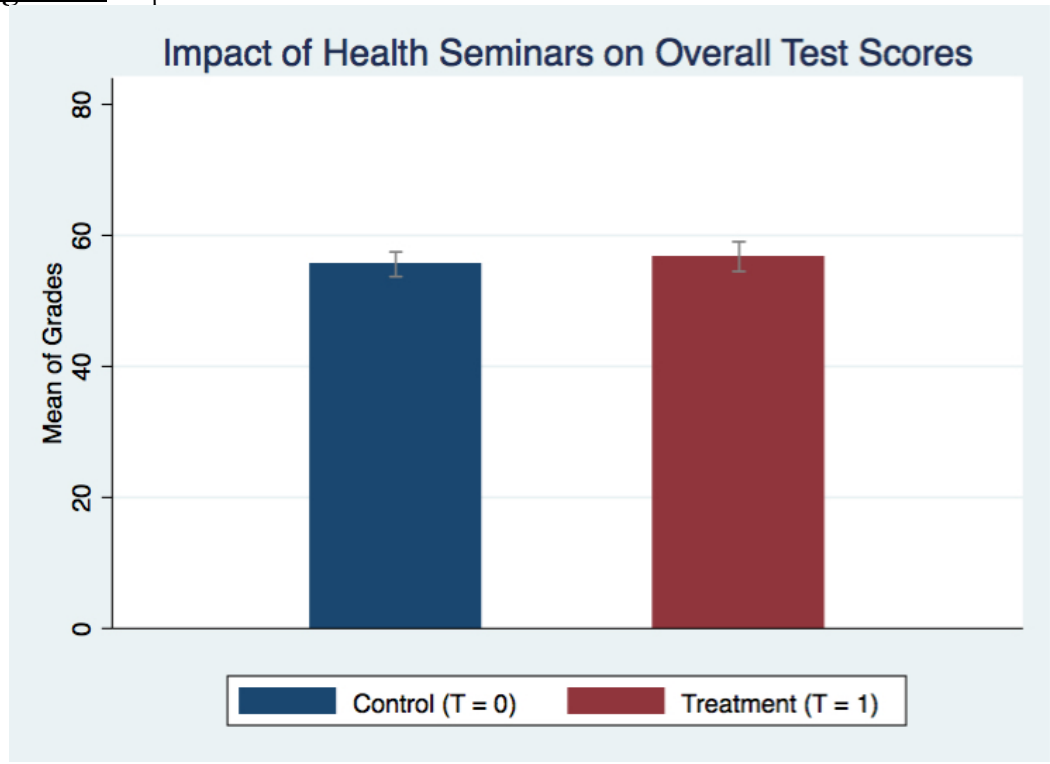
Figure 15: Impact of AFRIPads on test scores between control and treatment categorized by income proxy / government school enrollment (Gov = 1)



***** Bars denote standard errors*****

***** No significant change in test scores for groups that received AFRIPads versus the control group, driven by subset of population enrolled in government schools.

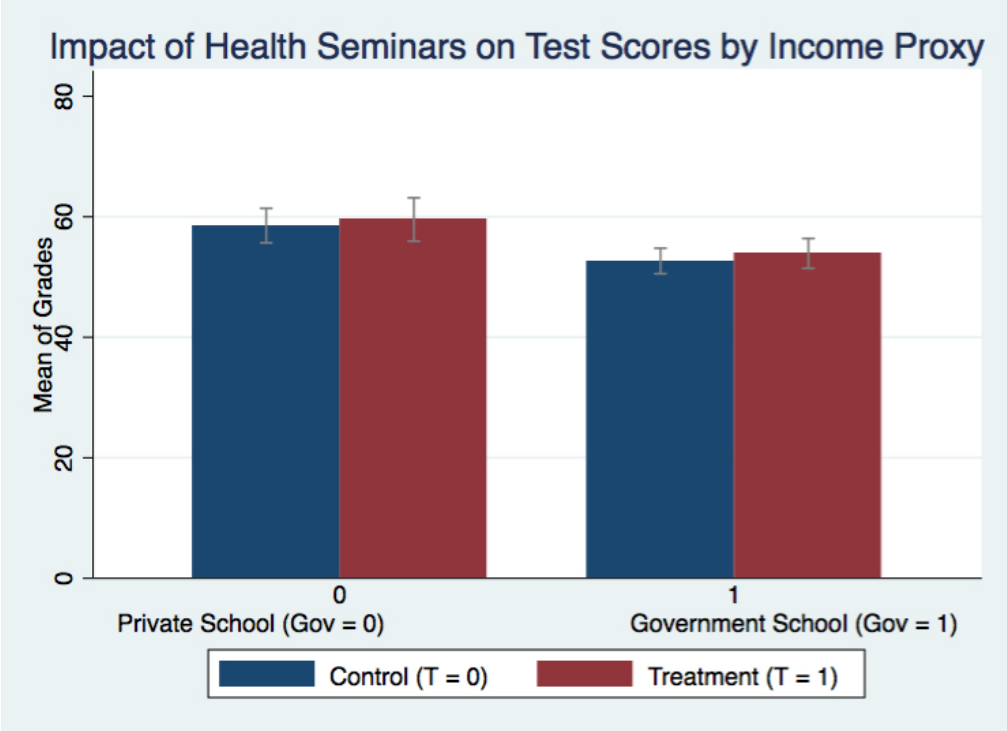
Figure 16: Impact of health seminar on overall test scores between control and treatment



***** Bars denote standard errors*****

***** No significant change in test scores for groups that received health seminars versus the control group.

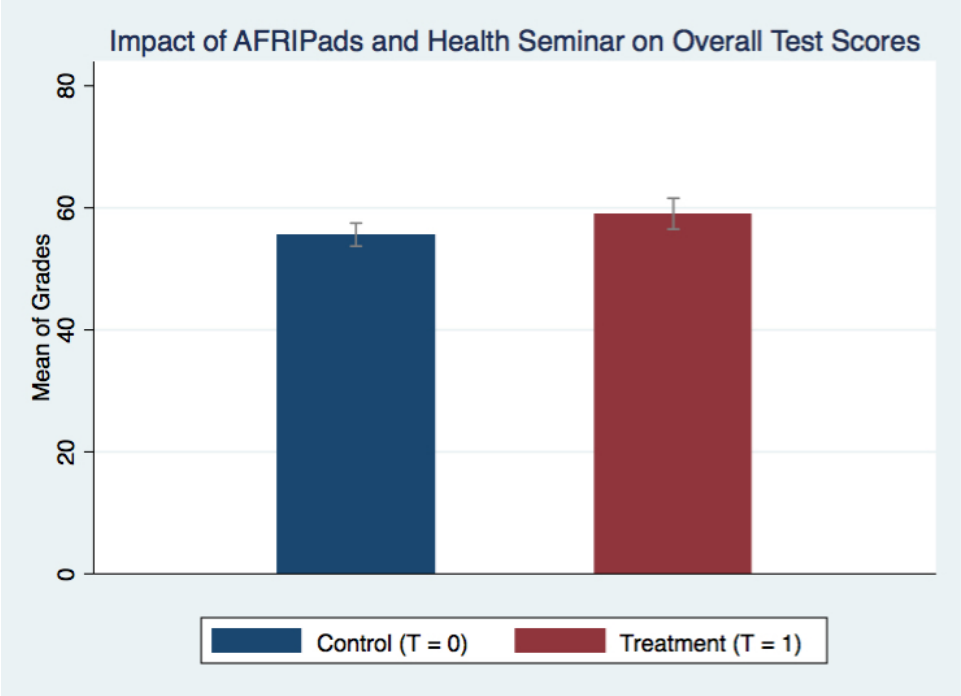
Figure 17: Impact of health seminar on test scores between control and treatment categorized by income proxy / government school enrollment (Gov = 1)



***** Bars denote standard errors*****

***** No significant change in test scores for groups that received health seminars versus the control group, driven by subset of population enrolled in government schools.

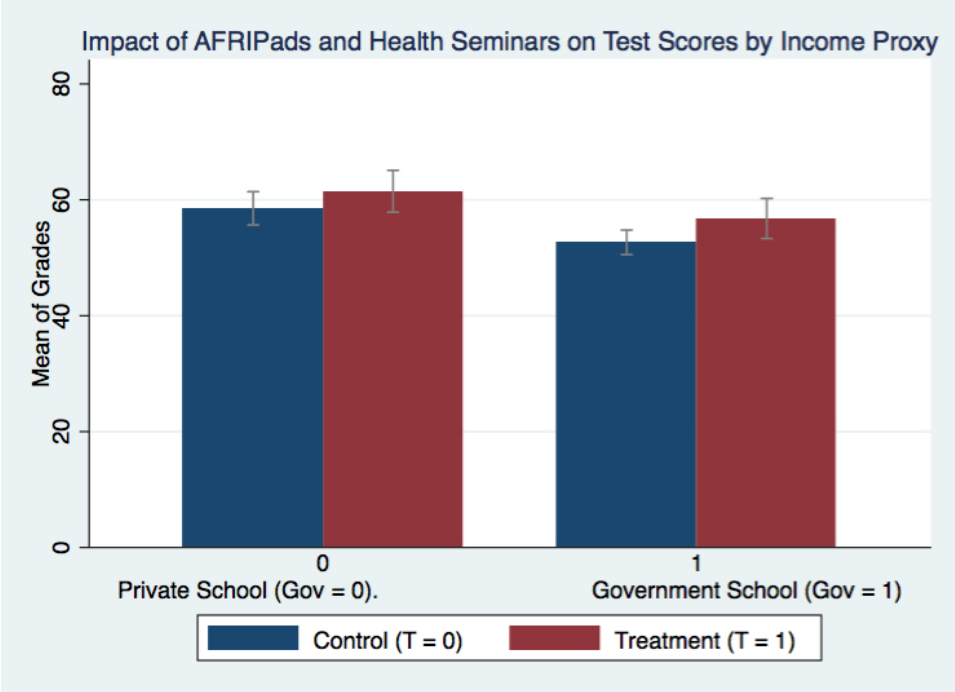
Figure 18: Impact of, both, AFRIPads and health seminar on overall test scores between control and treatment



***** Bars denote standard errors*****

***** No significant change in test scores for groups that received AFRIPads and health seminars versus the control group.

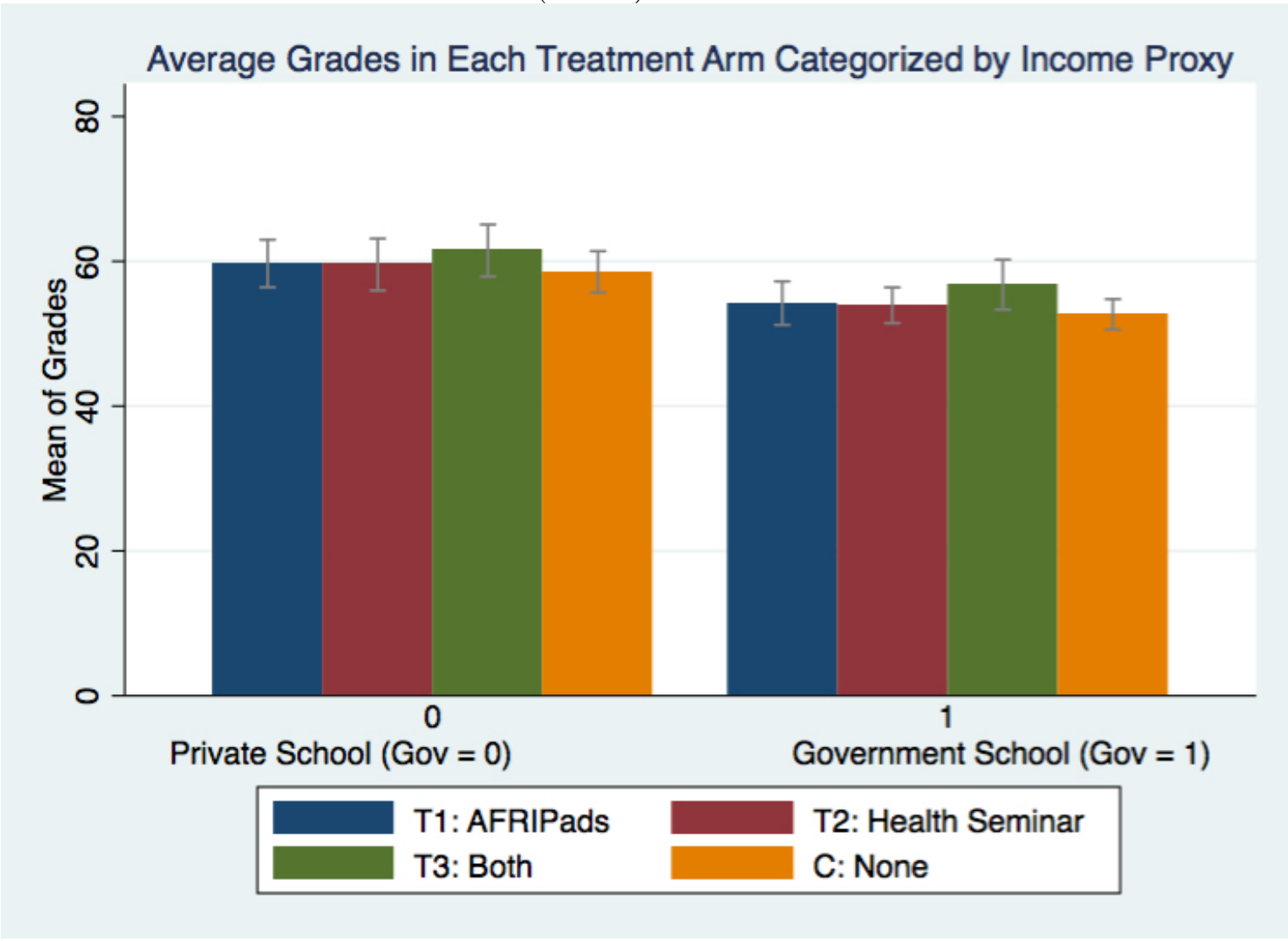
Figure 19: Impact of, both, AFRIPads and health seminar on test scores between control and treatment categorized by income proxy / government school enrollment (Gov = 1)



***** Bars denote standard errors*****

***** No significant change in test scores for groups that received AFRIPads and health seminars versus the control group, driven by subset of population enrolled in government schools.

Figure: 20 Impact of all treatments on test scores between control and treatment categorized by income proxy / government school enrollment (Gov = 1) at endline



***** Bars denote standard errors*****

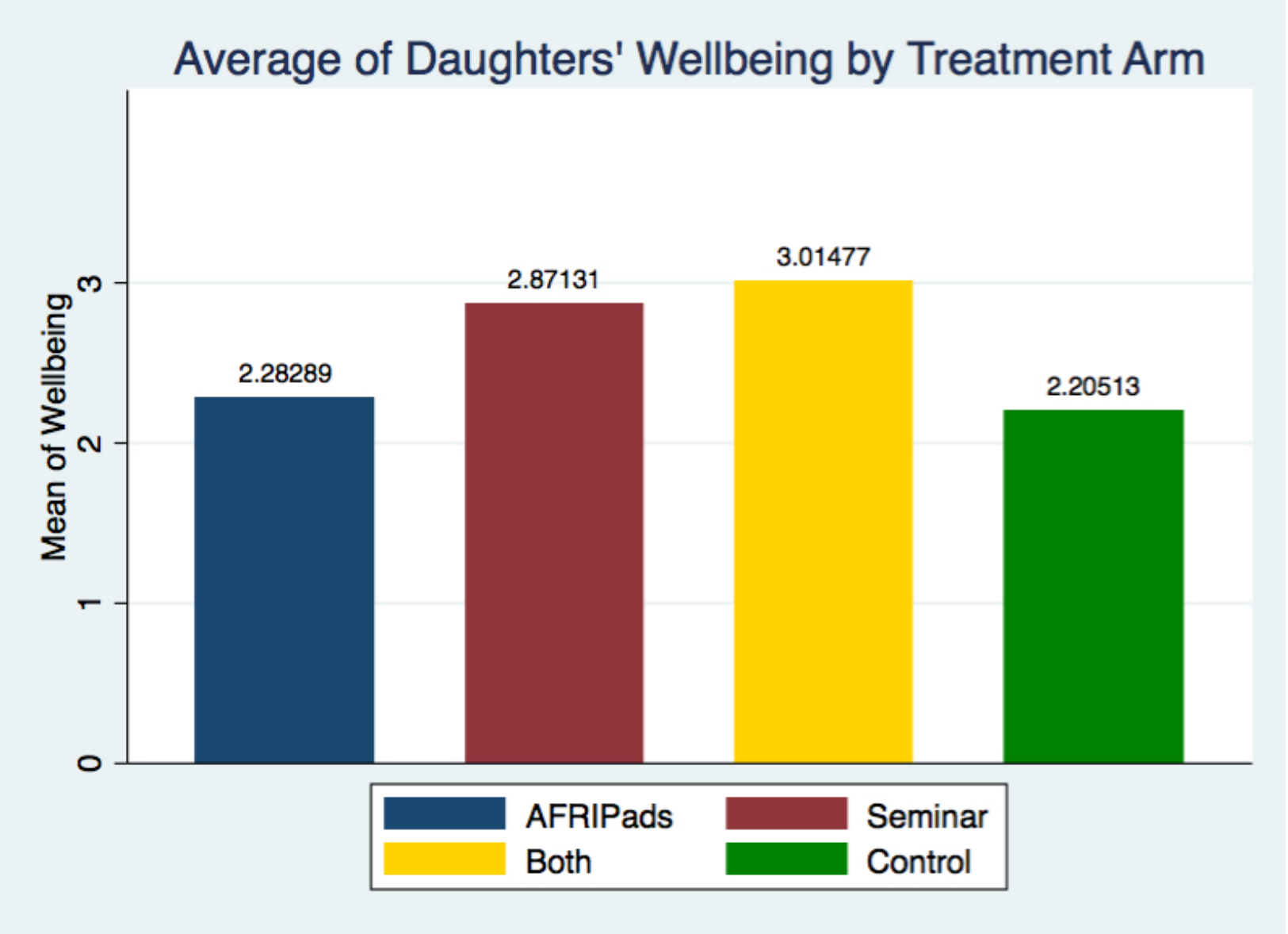
Table 8: Impact of All Treatments on Social and Psychological Wellbeing of Daughters

	Model (I) Wellbeing	**Model (II) Wellbeing**	**Model (III) Wellbeing**	**Model (IV) Wellbeing**
AFRIPads	0.078	0.077	0.073	0.021
	(0.104)	(0.104)	(0.101)	(0.132)
Seminar	0.666***	0.666***	0.666***	0.665***
	(0.134)	(0.134)	(0.135)	(0.175)
Both (AFRIPads & Seminar)	0.066	0.068	0.069	0.041
	(0.151)	(0.150)	(0.146)	(0.191)
Government School *(Income Proxy)*		-0.067	-0.063	-0.128
		(0.120)	(0.086)	(0.158)
Age			-0.113***	-0.113***
			(0.023)	(0.023)
AFRIPads X Gov *(Heterogeneous Variable: I)*				0.104
				(0.201)
Seminar X Gov *(Heterogeneous Variable: II)*				0.001
				(0.272)
Both X Gov *(Heterogeneous Variable: III)*				0.052
				(0.203)
Constant	2.205***	2.239***	3.882***	3.913***
	(0.095)	(0.110)	(0.301)	(0.297)
R-squared	0.179	0.173	0.2469	0.2485
N	312	312	312	312

Standard errors reported in parentheses. * significant at 10% **significant at 5% ***significant at 1%

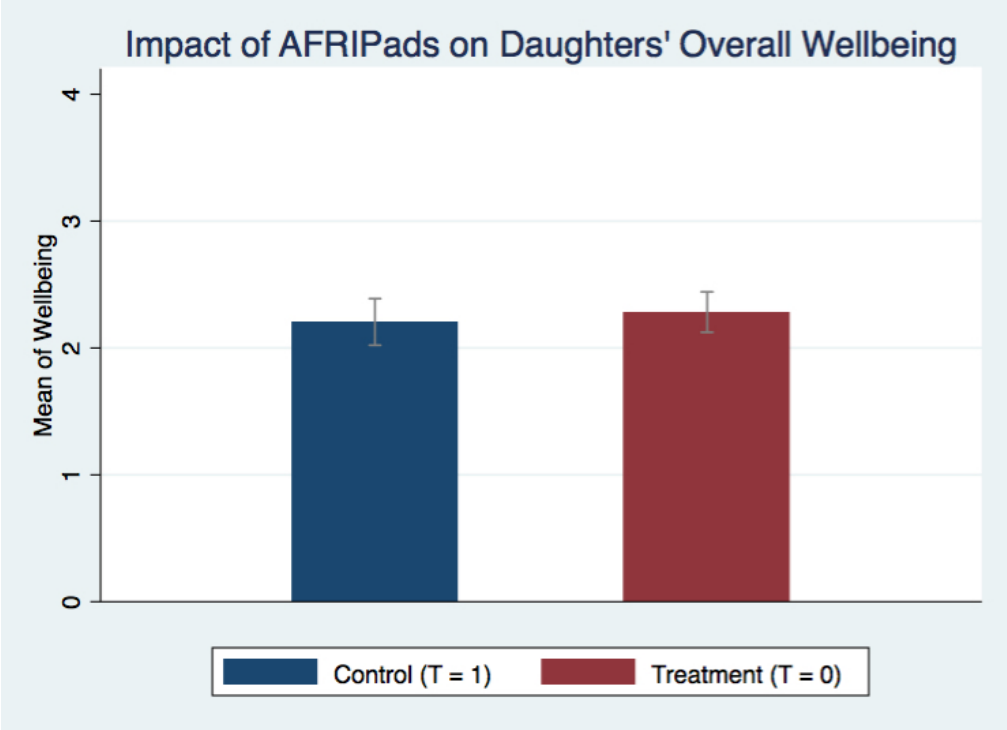
This table reports the impact of AFRIPads, health seminar and both of these treatments on the daughters' wellbeing (in comparison to the respective control groups). Here, the measure of wellbeing is the average of six variables of interest. Models (I) and (II) access the impact of AFRIPads, Health seminar and both treatments on absence respectively. Models (III) and (IV) demonstrate the impact of the aforementioned treatments but with the addition of control variables like enrollment in government-run schools or age. Models (V), (VI) and (VIII) capture the impact of aforementioned treatments along with the interaction variable – i.e. the heterogeneous impact of AFRIPads, Seminar and, both, AFRIPads and Seminar upon the absence of government school girls.

Figure 21: The wellbeing for daughters categorized by each treatment arm at endline



***** Bars denote standard errors*****

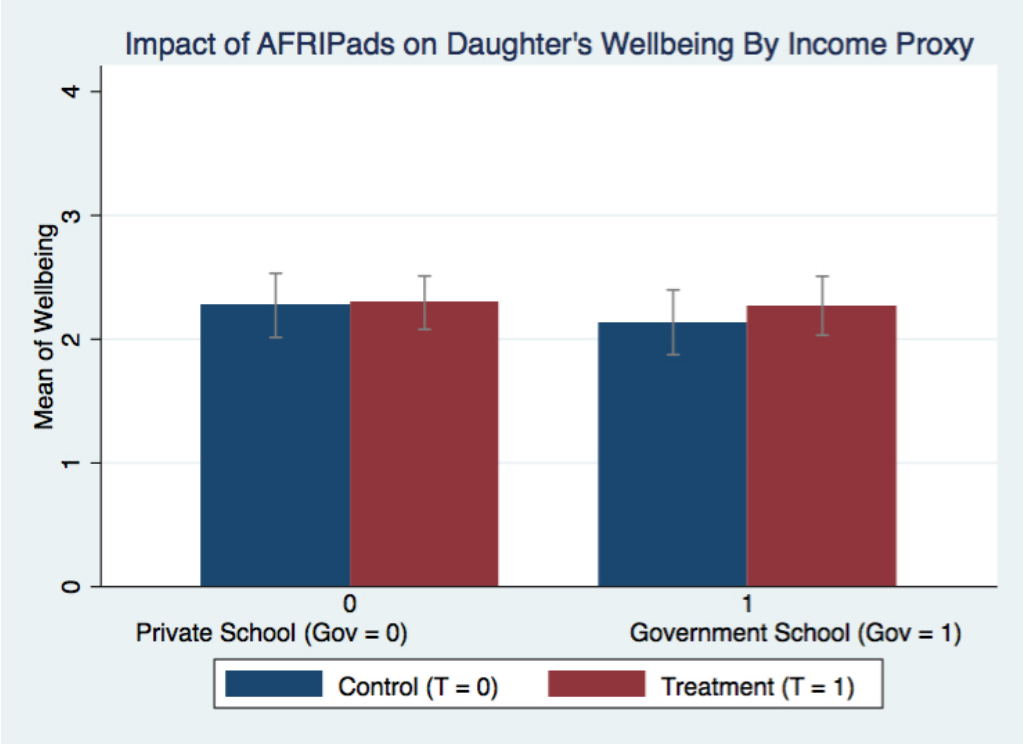
Figure 22: Impact of AFRIPads on daughters' overall wellbeing between control and treatment



***** Bars denote standard errors*****

***** No significant increase in wellbeing for groups that received AFRIPADs versus the control.

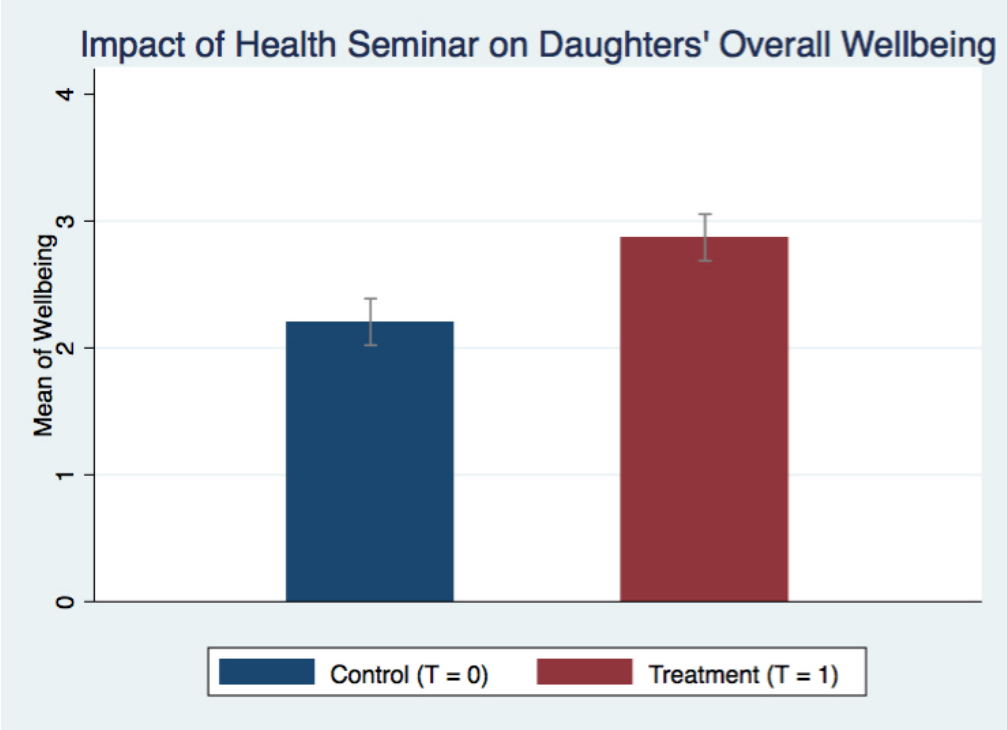
Figure 23: Impact of AFRIPads on daughter's wellbeing between control and treatment categorized by income proxy / government school enrollment (Gov = 1)



***** Bars denote standard errors*****

***** No significant increase in wellbeing for groups that received AFRIPads versus the control group, driven by subset of population in government schools.

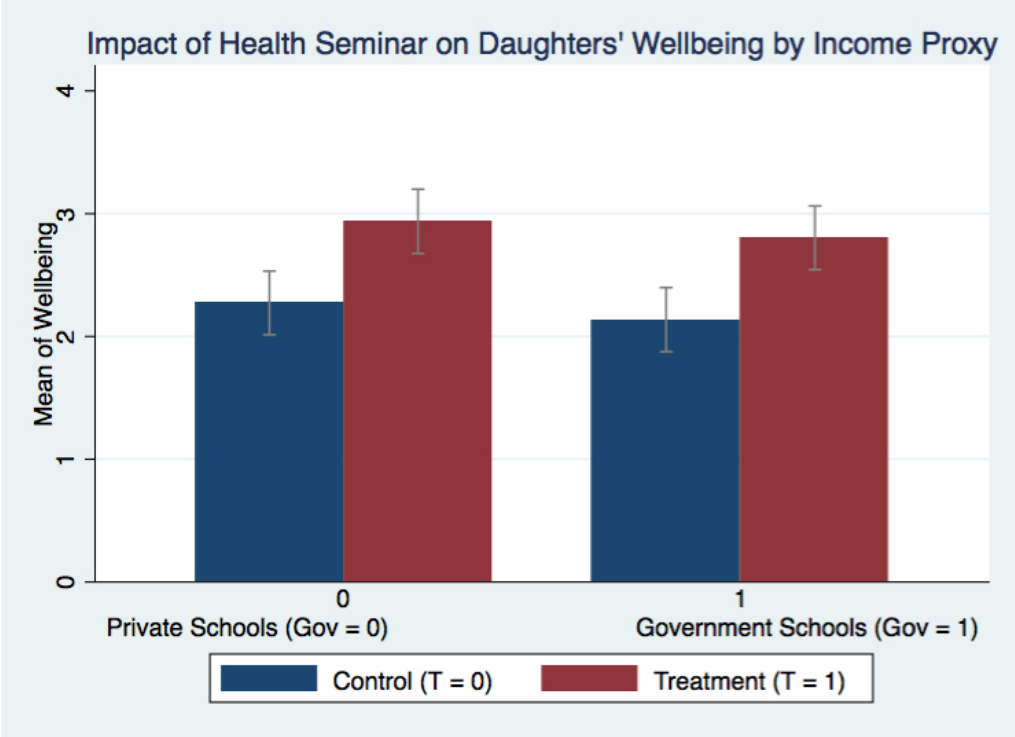
Figure 24: Impact of health seminar on daughters' overall wellbeing between control and treatment



***** Bars denote standard errors*****

***** Significant increase in wellbeing for groups that received health seminars versus the control.

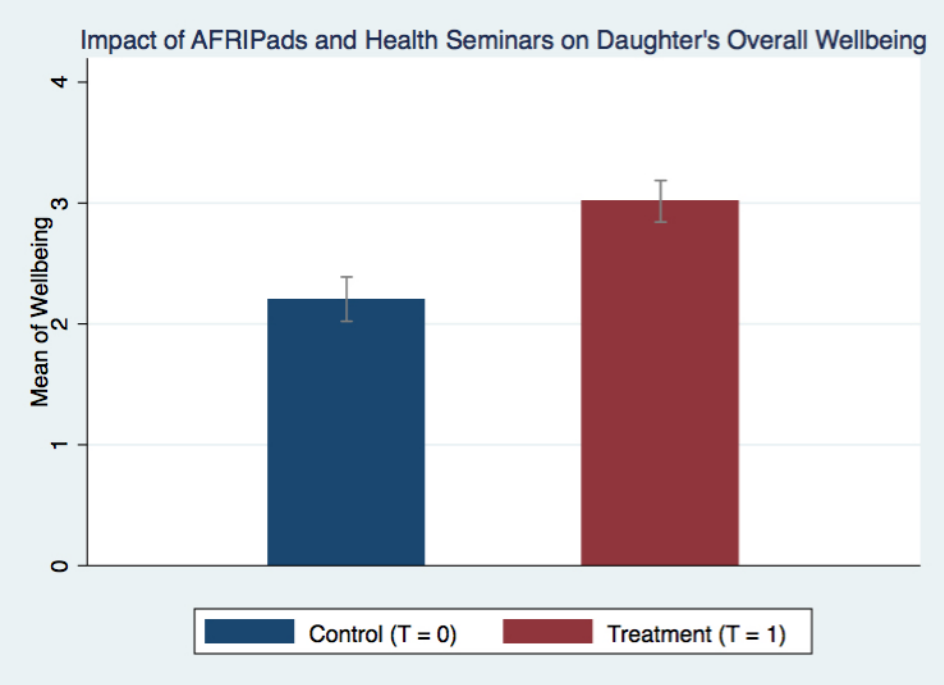
Figure 25: Impact of health seminar on daughter's wellbeing between control and treatment categorized by income proxy / government school enrollment (Gov = 1)



***** Bars denote standard errors*****

***** Significant increase in wellbeing for groups that received health seminars versus the control group, driven by the entire population across the income proxy.

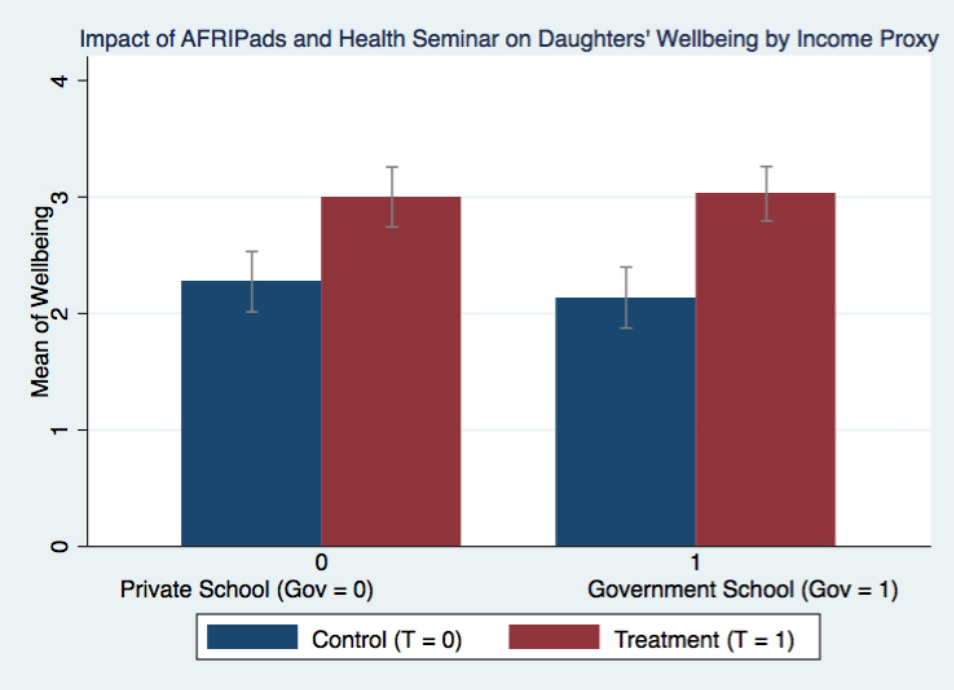
Figure 26: Impact of, both AFRIPads and health seminar on daughters' overall wellbeing between control and treatment



***** Bars denote standard errors*****

***** Significant increase in wellbeing for groups that received AFRIPads and health seminars versus the control.

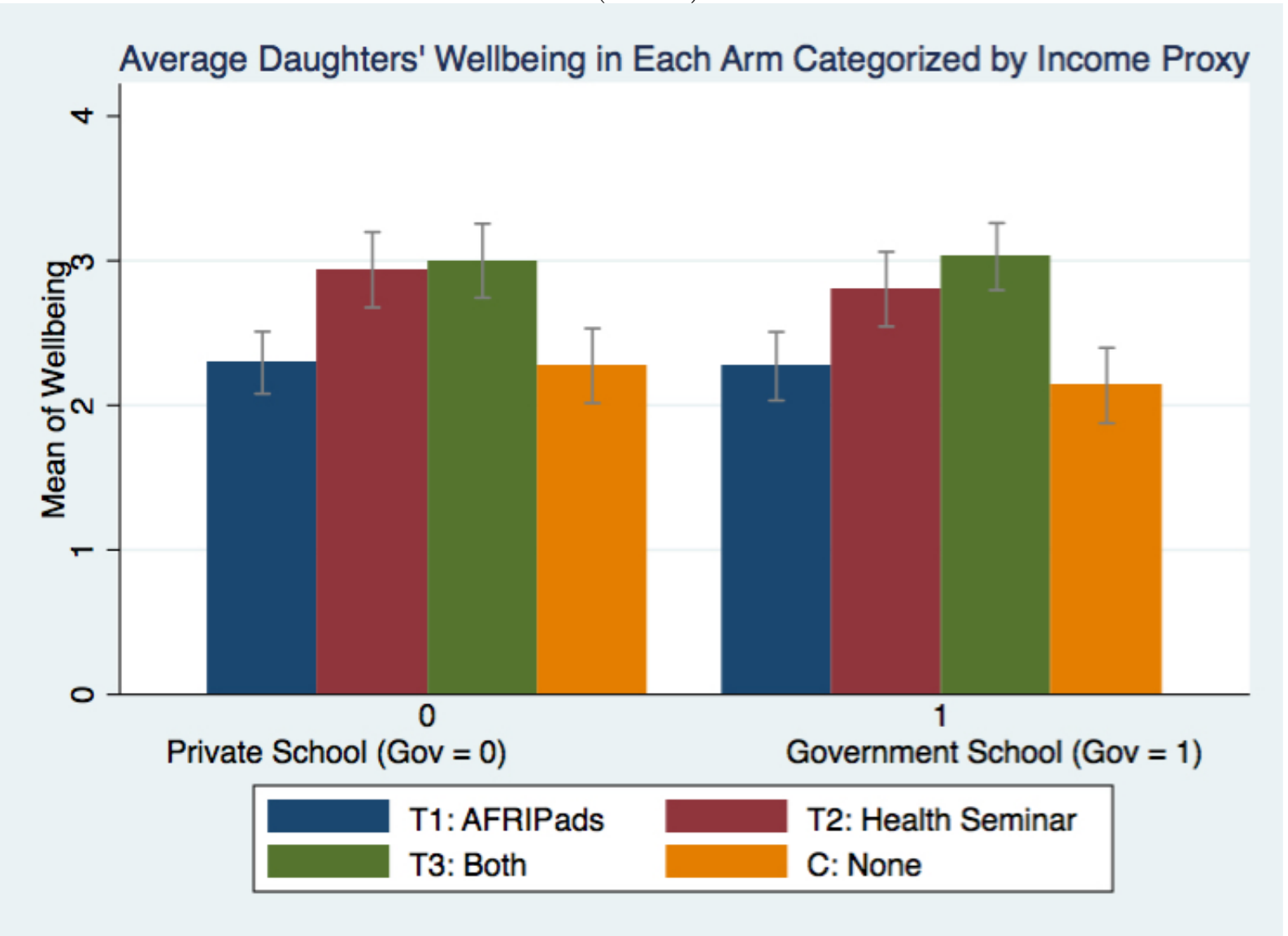
Figure 27: Impact of, both AFRIPads and health seminar on daughters' overall wellbeing between control and treatment categorized by income proxy / government school enrollment (Gov = 1)



***** Bars denote standard errors*****

***** Significant increase in wellbeing for groups that received health seminars versus the control group, driven by the entire population across the income proxy.

Figure: 28 Impact of all treatments on daughters' wellbeing between control and treatment categorized by income proxy / government school enrollment (Gov = 1) at endline



***** Bars denote standard errors*****

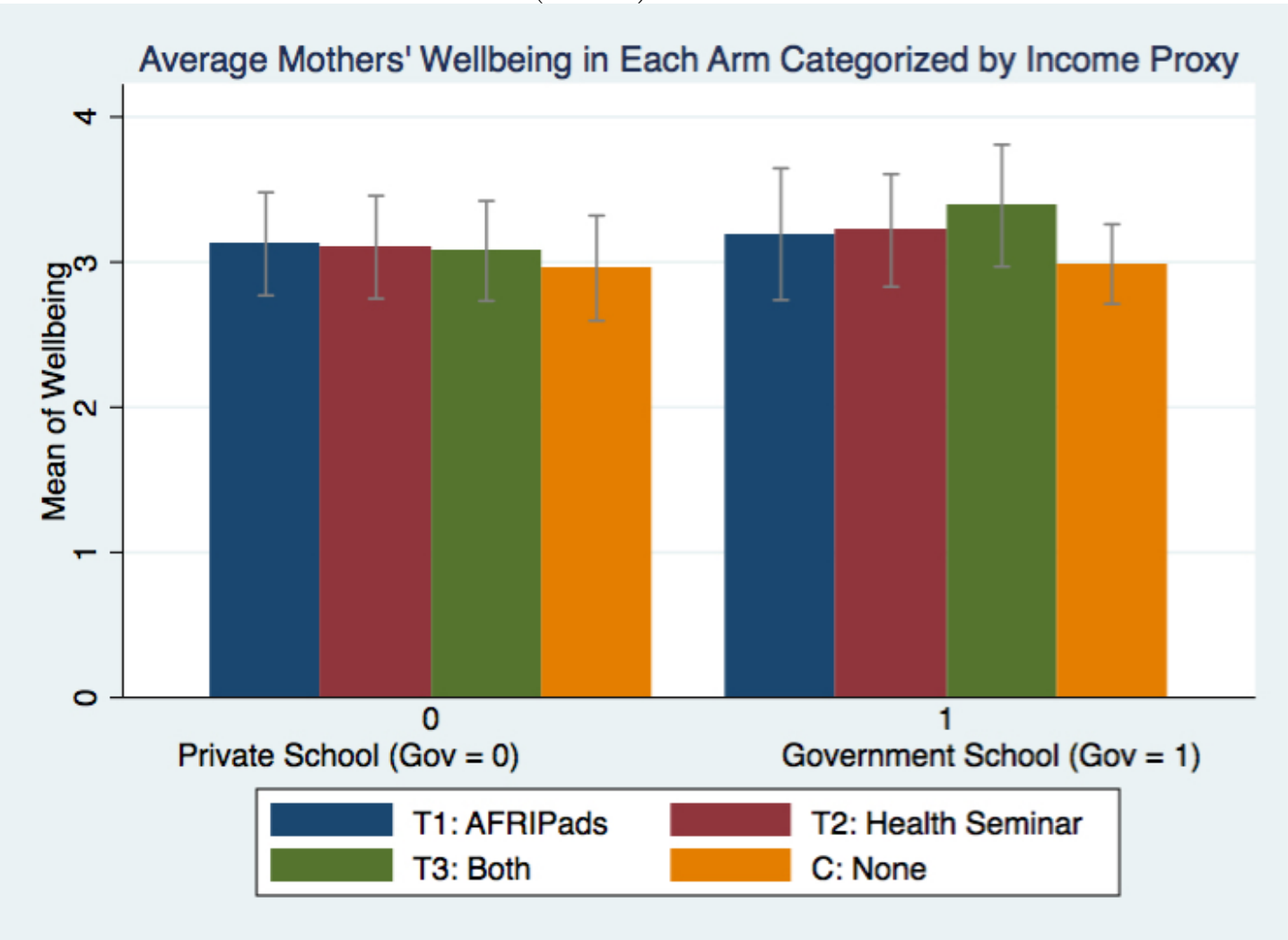
Table 9: Impact of All Treatments on Social and Psychological Wellbeing of Mothers

	Model (I) Wellbeing	Model (II) Wellbeing	Model (III) Wellbeing	Model (IV) Wellbeing
AFRIPads	0.188 (0.188)	0.185 (0.188)	0.176 (0.166)	0.155 (0.239)
Seminar	0.188 (0.186)	0.188 (0.186)	0.189 (0.164)	0.125 (0.235)
Both (AFRIPads & Seminar)	-0.121 (0.263)	-0.116 (0.263)	-0.123 (0.232)	-0.180 (0.332)
Government School *(Income Proxy)*		0.131 (0.132)	0.130 (0.116)	0.010 (0.239)
Age			0.072*** (0.013)	0.077*** (0.024)
AFRIPads X Gov *(Heterogeneous Variable: I)*				0.051 (0.335)
Seminar X Gov *(Heterogeneous Variable: II)*				0.120 (0.332)
Both X Gov *(Heterogeneous Variable: III)*				0.119 (0.470)
Constant	2.972*** (0.134)	2.907*** (0.150)	0.209 (0.524)	0.266 (0.538)
R-squared	0.021	0.031	0.255	0.263
N	100	100	100	100

Standard errors reported in parentheses. * significant at 10% **significant at 5% ***significant at 1%

This table reports the impact of AFRIPads, health seminar and both of these treatments on the mothers' wellbeing (in comparison to the respective control groups). Here, the measure of wellbeing is the average of six variables of interest. Models (I) and (II) access the impact of AFRIPads, Health seminar and both treatments on absence respectively. Models (III) and (IV) demonstrate the impact of the aforementioned treatments but with the addition of control variables like enrollment in government-run schools or age. Models (V), (VI) and (VIII) capture the impact of aforementioned treatments along with the interaction variable – i.e. the heterogeneous impact of AFRIPads, Seminar and, both, AFRIPads and Seminar upon the absence of government school girls.

Figure: 29 Impact of all treatments on mothers' wellbeing between control and treatment categorized by income proxy / government school enrollment
(Gov = 1) at endline



***** Bars denote standard errors*****