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Menstruation, Sanitary Products, and School Attendance: Evidence from a Randomized Evaluation[†]

By EMILY OSTER AND REBECCA THORNTON*

Policy-makers have cited menstruation and lack of sanitary products as barriers to girls' schooling. We evaluate these claims using a randomized evaluation of sanitary products provision to girls in Nepal. We report two findings. First, menstruation has a very small impact on school attendance. We estimate that girls miss a total of 0.4 days in a 180 day school year. Second, improved sanitary technology has no effect on reducing this (small) gap. Girls who randomly received sanitary products were no less likely to miss school during their period. We can reject (at the 1 percent level) the claim that better menstruation products close the attendance gap. (JEL I21, J13, J16, O12)

Increasing female education is an important policy priority in many developing countries. Girls lag behind boys in schooling attainment, and female schooling is thought to be important for a variety of development outcomes (Barbara L. Wolfe and Jere R. Behrman 1987; Behrman and Wolfe 1989; Paul Glewwe 1999; Behrman and Mark R. Rosenzweig 2002). A number of researchers and policy-makers have argued the importance of menstruation in limiting school attendance and attainment (Yewoubdar Beyene 1989; Barbara Herz et al. 1991; Golnar Mehrah 1995; Annemarieke Mooijman et al. 2005; Marni Sommer 2010). The World Bank has put concrete numbers on the menstruation problem. If a girl misses 4 days of school every 4 weeks due to her period, she will miss 10 to 20 percent of her school days (Mooijman et al. 2005; Varina Tjon A Ten 2007).

The possible role for menstruation in limiting school attendance has received significant attention in popular media, nearly all of which argues that menstruation is likely to be a significant factor in schooling (e.g., Anne Mawathe 2006; Paulus Kayiggwa 2007; Nicholas D. Kristof and Sheryl WuDunn 2009; BBC News 2010).

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[†]To comment on this article in the online discussion forum, or to view additional materials, visit the article page at <http://www.aeaweb.org/articles.php?doi=10.1257/app.3.1.91>.

For example, Kristof (2009) writes: “education experts increasingly believe that a cost-effective way to keep high school girls from dropping out in poor countries is to help provide them with sanitary products.” These arguments are based largely on anecdotal evidence; girls report missing school during their period and report limited access to modern sanitary products.

In response, a number of non-governmental organizations (NGOs) and sanitary product manufacturers have begun campaigns to increase availability of sanitary products, with a stated goal of improving school attendance (Jeanette Cooke 2006; Claudia H. Deutsch 2007; Lynn Clark Callister 2008). The largest of these is a program by Procter and Gamble, which has pledged \$5 million toward providing puberty education and sanitary products, with the goal of keeping girls in school (Deutsch 2007). The Clinton Global Initiative has pledged \$2.8 million to aid businesses who provide inexpensive sanitary pads in Africa; again, the stated goal is improvement in school and work attendance. In addition to these large scale efforts, a number of smaller NGOs (UNICEF, FAWA, CARE) have undertaken similar programs (Sowmyaa Bharadwaj and Archana Patkar 2004, Cooke 2006).

Despite the money being spent on this issue, and the seeming media consensus on its importance, there is little or no rigorous evidence quantifying the days of school lost during menstruation or the effect of modern sanitary products on this time missed.¹ Existing evidence is largely from anecdotes and self-reported survey data. This fails to give a sense of the depth of the issue. Even if every girl reports missing school one day a year during her period, the problem may be widespread, but not large in magnitude. The evidence on sanitary products has similar problems.²

In this paper, we provide the first rigorous evidence on how much school girls actually miss during their periods, and the causal effect of modern sanitary technology on school attendance. We collected daily data in Nepal on girls’ school attendance and menstrual calendars for up to a year. This allows us to directly estimate the impact of periods on school attendance. Further, we randomized access to a menstrual cup (a sanitary product which is used internally during menstruation), and we evaluate the attendance impact.

We first present estimates of the effect of menstruation on school attendance using official attendance data for every day of the study and time diary data for a subset of days. We estimate the difference in attendance rates between days on which the girl has her period and days on which she does not, controlling for individual and

¹ One exception, although not about schooling, is Andrea Ichino and Enrico Moretti (2009) who note a 28-day cycle of absence among female Italian bank employees and argue that menstruation accounts for higher absence rates and lower wages in this population. This conclusion has been questioned by Jonah Rockoff and Mariesa Herrmann (2009). Maimaiti Yasheng and W. S. Siebert (2009) report differences in dropout rates by girls with and without their period in China. However, they do not have good attendance data, and it is difficult to rule out omitted variable stories. They also do not address sanitary product provision.

² A recent quantitative study has similar issues. Linda Scott et al. (2009) report results from a study in Ghana in which they allocated sanitary pads to some villages and not others and reported impacts on school attendance. However, the study contains only four villages (meaning there are effectively four observations), which were not randomly assigned, the attendance data are self-reported, and they do not appear to have collected data by days of menstruation. Moreover, although the study argues for the benefits of sanitary pads (BBC News 2010), they in fact find very similar effects when only menstrual education is provided.

calendar date fixed effects.³ We find the impact of menstruation on school attendance is significant and negative, but extremely small. In the official attendance data, girls are 2.4 percentage points less likely to attend school on days they have their period. Because girls have their period on about 8 percent of school days, this amounts to missing 0.35 days in a 180 day school year. We can reject (at the 5 percent level) effects larger than 0.66 school days missed in a 180 day school year. As a comparison, the hypothesized estimates from Mooijman et al. (2005) suggest between 18 and 36 school days missed.

Second, we use our randomized design to estimate the impact of the menstrual cup on school attendance. We compare attendance rates for girls in the treatment group (who were given the cup) and girls in the control group. Our central estimates focus on estimating treatment effects on days in which girls have their period.⁴

We find no impact of having access to the menstrual cup on school attendance. Using the official attendance data, on days when girls have their period, the cup induces an insignificant 1.0 percentage point *decrease* in attendance. We can reject at the 5 percent level cup effects larger than 0.35 days gained in a 180 day school year. Even more precise, we can reject at the 1 percent level the claim that the cup closes the small attendance gap induced by the period.

Overall, we highlight two results. First, the attendance gap induced by menstruation is very small, at less than one day per year. Second, we are able to reject that better sanitary technology closes this small gap. We conclude that policies to address this issue are unlikely to result in schooling gains.

I. Experimental Design and Data

Study Timeline and Experimental Design.—This study was run between November 2006 and January 2008 in four schools in Chitwan District, Nepal. We invited all seventh and eighth grade girls enrolled in four schools, along with their mothers, to a preliminary study meeting. One hundred ninety-eight girls attended the meeting and were enrolled in the study. At this meeting, we administered a baseline survey with questions on demographics, schooling, and menstruation. Girls were given a booklet of time diaries for each month. These diaries included a menstrual calendar on which they were to note the start and end date of their period in each month. Summary statistics on the sample can be seen in panel A of Table 1.

At the end of the initial meeting, a public lottery was carried out and 25 girls in each school were assigned to the treatment group. Treatment girls remained at the meeting, and they (and their mothers) were given a menstrual cup and instructions

³ Although this analysis does not take advantage of our randomized design, given the context and specification it seems unlikely that these estimates would be biased. More specifically, the estimates here will be biased if there is something else systematically different about the days that girls have their period versus those that they do not. Given that there is wide variation in when in the month the period occurs, within person, it is difficult to imagine what this bias would be.

⁴ One concern is that girls do not use the menstrual cup, which would limit our ability to pick up any effects. However, adoption rates are fairly high at around 60 percent. We report evidence on adoption patterns in more detail elsewhere (Oster and Thornton 2009).

TABLE 1—SUMMARY STATISTICS AND BALANCING TESTS

	Mean	SD	Observations
<i>Panel A. Sample summary statistics</i>			
Age	14.2	1.23	198
Grade	7.5	0.50	198
Baseline exam score	0.00	1.00	198
Father Hindu ethnicity	0.47	0.50	198
Mother's years of education	2.69	3.90	190
Father's years of education	5.61	4.71	190
Work for pay	0.22	0.41	198
Income category	2.52	1.59	190
Menses at baseline (0/1)	0.87	0.33	198
Share of days attended (official)	0.86	0.10	198
Share of days attended (time diary)	0.56	0.13	197
	Treatment (<i>N</i> = 98)	Control (<i>N</i> = 101)	Difference
<i>Panel B. Balancing tests</i>			
Age	14.208	14.237	-0.029
Grade	7.495	7.443	0.052
Exam score	-0.056	0.058	-0.147
Father Hindu ethnicity (0/1)	0.465	0.485	-0.020
Mother's years of education	2.480	2.913	-0.433
Father's years of education	6.020	5.174	0.846
Work for pay	0.218	0.216	0.002
Income category	2.449	2.598	-0.118
Menses at baseline (0/1)	0.921	0.825	0.096**

Notes: This table shows simple summary statistics on sample sizes and basic demographics. All girls were in either seventh or eighth grade. Age at menarche and ever used pads reported only for girls who have their menses at baseline. Exam score measures pre-intervention test scores normalized to have a mean of zero and a standard deviation of one. Income categories range from 1–6, and correspond to yearly incomes of less than Rs 25,000 (<\$340), Rs 25k–50k (\$340–\$680), Rs 50k–75k (\$680–\$1,020), Rs 75k–100k (\$1,020–\$1,360), Rs 100k–150k (\$1,360–\$1,700), and Rs 150k+ (\$1,700+).

**Significant at the 5 percent level.

on how to use it.⁵ Time diaries and menstrual calendars were collected at each month from each girl. At the end of the study, a second meeting was held in each school. A follow-up survey, similar to the baseline survey, was administered, and the control girls and their mothers were given the menstrual cup.

Sanitary Technology.—The sanitary technology we use is a menstrual cup, specifically the Mooncup brand cup.⁶ This product is a small, silicone, bell-shaped cup which is inserted in the vagina to collect menstrual blood. Between uses, the cup is washed with soap and water and stored in a cloth bag. With proper care, the cup is reusable for up to a decade.

In the area of Nepal where our experiment takes place, the primary protection women use during their period is menstrual cloths (98 percent of girls in our sample report using cloths, and 75 percent used them exclusively prior to the cup). These

⁵ One of the mother-daughter pairs randomized to the treatment group decided not to accept the menstrual cup. We analyze the intention to treat effect, and keep this girl in our sample for analysis. This girl and her mother were each interviewed at the follow-up survey.

⁶ For more information, see <http://www.mooncup.co.uk/>. Similar cups are sold under the name Keeper and Diva Cup. There is no risk of toxic shock syndrome, and generally no risk of complications from the cup. Menstrual cups are Food and Drug Administration (FDA) approved in the United States.

cloths are placed inside a woman's underwear to soak up menstrual blood, then washed and re-used. The menstrual cup may be preferable for various reasons. The primary reasons cited by our respondents were increased mobility and less laundry time.

Data Used.—We use two primary elements of the study data: data on menstrual timing and data on school attendance. Data on menstrual timing is available directly from the girl's menstrual calendars.⁷ Our primary measure of school attendance is official school records, which are collected daily for each student in each school and are available for the entire year of the intervention. We supplement these data with information from the time diaries, filled out by the girls themselves.⁸ These were designed to cover only the first six days of each month, and we exclude Saturdays since school is not held that day. Average attendance rates are summarized in panel A of Table 1. Attendance is lower in the time diaries largely because some days included in these diaries are holidays. The results are very similar if we exclude days with low attendance overall.

II. Results: Impact of Menstruation and Sanitary Technology

A. Impact of Menstruation on School Attendance

To estimate the impact of a girl's period on school attendance, we limit our analysis to the girls in the control group since we are interested in estimating the impact of the period on girls with access to poor sanitary technologies. The primary result can be seen graphically in the first two columns of Figure 1, which show attendance rates (from the official attendance data) for control girls on days with and without menstruation. Attendance is slightly lower on period days, but only very slightly. Attendance probability falls from 85.7 percent on days without menstruation to 83.0 percent on days with menstruation.

Panel A of Table 2 shows our statistical estimates of the effect of the period on school attendance, using regressions with individual and calendar date fixed effects. Column 1 reports on the official daily attendance data. There is a negative and significant effect of the period. The coefficient is -0.024 , indicating that girls are 2.4 percentage points less likely to attend school on days they have their period. The average girl has her period about 8 percent of school days in our data, which translates to 0.19 percent of school missed due to the period, or about 0.35 days in a 180 day school year. We can reject, at the 5 percent level, effects of 0.66 days per school year. The coefficient from the time diary is similar (4.2 percentage points),

⁷ Although we made an effort to collect all time diaries, we did miss some months, and for these months we do not observe period dates. Missing months are concentrated toward the end of the study. Our results are robust to either not including these months in the study or including only individual-months in which we observe the period dates. In either case, the coefficients are extremely similar to what we observe in our primary estimates (results available from the authors).

⁸ We also undertook random attendance checks at schools on a small subset of days. These results are reported in the Online Appendix.

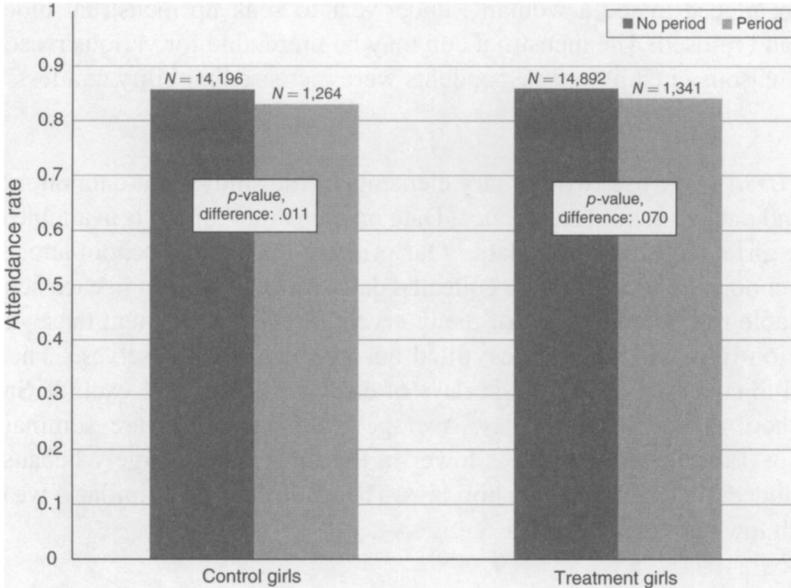


FIGURE 1. ATTENDANCE RATES, PERIOD, AND NON-PERIOD DAYS

Notes: This figure shows attendance rates (from official attendance data) for girls in our sample on period and non-period days. The first set of columns uses control girls who have access only to poor sanitary technology. The second set of columns uses treatment girls, who have access to the menstrual cup.

although only significant at the 10 percent level.⁹ These effects are extremely small. Even at the upper bound, missing three-quarters of a day in each school year seems unlikely to seriously impact learning.

B. Impact of Menstrual Cup on Attendance

We turn now to using our randomized evaluation to estimate whether the menstrual cup closes any of the (small) gap in days missed due to the period. Given the small gap in attendance on period days, the potential upside of the cup (or any sanitary technology) is limited.

In this analysis, we make use of the randomized evaluation component of our study. Half of the girls in the sample were allocated a menstrual cup and half were not. Our primary estimates rely on comparing attendance rates in the period after the cup was allocated between treatment and control girls. To do this, we simply estimate an OLS regression of attendance on a dummy for being in the treatment group, plus demographic controls and date fixed effects. In addition, we take advantage of variation across period and non-period days, combined with the randomization. In

⁹ We could limit the time diary analysis to days for which we also have data from the official attendance reports, so we know school is in session. The results are of similar magnitude but less precise if we do this. However, there are some dates when many students report being in school in the time diaries, but attendance is not recorded, likely due to the fact that the teacher misses recording on some days. Restricting the time diary sample to only days in which we observe official attendance data therefore ignores a significant amount of informative data.

this latter analysis, we estimate the impact of period days interacted with being in the treatment group. There is variation within individual in period days, so we are able to undertake this analysis controlling for individual-specific fixed effects.

An important issue in any randomized evaluation is balancing. In general, the groups are balanced (panel B of Table 1). However, treatment girls were more likely to have started their period. The results here are robust to restricting our sample to girls who had their period at the baseline survey.¹⁰ A second issue in this particular setting is whether girls used the cup. If adoption is very limited, we may not see impacts simply because of nonuse. In fact, adoption is relatively high, especially in the later half of the sample: by six months into the study, 60 percent of girls were using the cup (details of adoption are reported in Oster and Thornton 2009). Here we report the intent-to-treat estimates; in the Online Appendix we show treatment-on-treated effects which yield similar results.

The effect of the cup can be seen graphically by comparing the two sets of columns in Figure 1. The difference in attendance rates for period and non-period days is very similar for control girls (the first set of columns) and treatment girls (the second set). There is little or no evidence of higher attendance overall for the treatment group; the gap between period and non-period days is slightly smaller, although this does not hold true in the statistical analysis. Panel B of Table 2 presents the effects of the menstrual cup statistically. Columns 1 and 2 focus on the official attendance data. Column 1 shows that treatment girls are not significantly more likely to attend school on all days, and the estimated effect is small. Column 2 shows the impact of treatment status interacted with menstruation days. The effect of the period on school attendance is negative (as in panel A), but the interaction is also negative and not significant. In this case, we can reject at the 1 percent level that having access to the cup closes the period-day attendance gap. We can reject, at the 5 percent level, that the cup increases attendance by more than 0.35 days in a 180 day school year.

Columns 3 and 4 turn to the time diary data. The estimates are similar to the official attendance data, if perhaps slightly more favorable towards the menstrual cup. In column 4, the interaction between treatment and period days is actually positive and about the same size as the overall period effect (3.6 percentage points), although not significant. Again, the coefficient is small. We can reject at the 5 percent level effects larger than 1.6 days in a 180 day school year.

Overall, we find the menstrual cup does not significantly increase attendance. The upper limit of the possible effect is small, given the overall effect of the period, but even this small gap is not impacted by cup provision. This finding is consistent with girls' reports at the baseline as to why they missed school in the previous academic year during their period. Among those who reported ever missing during the year, the largest share—43.8 percent—listed cramps as the main reason why they did not

¹⁰ If girls who had begun their periods were in some way able to influence the survey team to enroll them into the treatment, this would threaten the validity of the randomization. There are several reasons why we believe this should not be a concern. First, the difference between the likelihood of menstruating among the treatment and control girls was only significantly different in one of the schools and the results are robust to excluding this school. Second, the randomization was a public lottery in front of all of the mothers and girls, making it difficult to game the system. Lastly, girls and their mothers did not know about the menstrual cup prior to the lottery and thus would not have incentive to try to get it.

TABLE 2—EFFECT OF MENSTRUATION AND MENSTRUAL CUP ON SCHOOL ATTENDANCE

	Official attendance data		Time diary data	
<i>Panel A. Impact of menstruation on school attendance</i>				
Period	−0.024** (0.011)		−0.043* (0.025)	
Individual fixed effects	Yes		Yes	
Calendar date fixed effects	Yes		Yes	
Observations	15,460		4,000	
Mean of dependent variable	0.85		0.55	
Estimated period impact, 180 day school year	−0.35 days		−0.60 days	
Effect size rejected at 5 percent level, 180 day school year	−0.66 days		−1.33 days	
<i>Panel B. Impact of menstrual cup on attendance</i>				
Treatment	0.003 (0.014)		−0.004 (0.016)	
Treatment period	−0.010 (0.017)		0.036 (0.039)	
Period	−0.023** (0.011)		−0.046* (0.025)	
Controls	Yes	No	Yes	No
Individual fixed effects	No	Yes	No	Yes
Calendar date fixed effects	Yes	Yes	Yes	Yes
<i>P</i> -value: period +	0.006		0.72	
Treatment × Period = 0				
Mean of dependent variable	0.86		0.55	
Estimated cup impact, 180 day school year	−0.15 days		0.51 days	
Effect size rejected at 5 percent level, 180 day school year	0.35 days		1.63 days	
Observations	29,499	31,693	7,100	8,075

Notes: This table reports the effect of days of menstruation and the menstrual cup on school attendance. Official attendance data is available for all days; time diaries are limited to the first six days of the month. In panel A, regression are limited to control girls who do not have access to the menstrual cup. Controls are age, grade, mother's education, work for pay, father's Hindu ethnicity, menses at baseline, and baseline exam score. Estimated impacts over the 180 day school year are reported for regressions with period interactions and assume the period occurs on 8 percent of school days (from our data). The effect size we reject at the 5 percent level is calculated as the maximum effect size allowed by the 95 percent confidence interval, estimated for the 180 day school year with the period on 8 percent of days.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

want to go to school during their period. Only about 20 percent reported washing rags or mobility restrictions as the main reason for missing school.¹¹

In the Online Appendix to this paper, we provide more detail and expand on our results. We demonstrate that there are no impacts of menstruation or the menstrual cup on time spent in school or on academic performance as measured by test scores and that treatment-on-treated estimates of the cup show no impact. Further, there is no impact on schooling on days just before the period (i.e., no evidence that

¹¹ We should note that, especially given this limited percentage of girls reporting mobility concerns, we are almost certainly underpowered to pick up any impact of the menstrual cup. The standard error on the treatment-period interaction in Table 2 is 0.017. Even if the menstrual cup closed the entire period gap (0.024), given this standard error we would not be able to reject no impact. Further, once we note that only about 50 percent of girls report ever missing school due to their period and only 20 percent of those report missing due to poor sanitary technology, the maximum effect size we could expect is about 0.0024, which we certainly do not have power to pick up given the standard errors.

premenstrual symptoms affect attendance) and no evidence of indirect effects of the period through friends behavior.

III. Conclusion

Policy advocates for girls' education have suggested there are large losses in schooling due to menstruation and the lack of proper sanitary hygiene in developing countries. This has resulted in media attention and money directed toward sanitary product provision, despite little or no hard evidence on possible impacts. In this paper, we use detailed data on period timing and school attendance to argue that the impact of menstruation on attendance is very small. We estimate girls miss about 0.4 days of school in a 180 day school year due to their period. Moreover, using a randomized evaluation we argue that providing better sanitary products (in our case, a menstrual cup) has no impact on closing this small attendance gap.

We should note that, despite this lack of impact on education, the menstrual cup *was* very popular with the girls in the study and had a significant time savings component, reducing time spent doing laundry. Take-up rates are high and girls in the sample report liking the product and have positive (hypothetical) willingness to pay for the cup. What we show in this paper is not that girls and women would not value better sanitary products, but simply that menstruation in general (and poor sanitary technology in particular) does not have a large impact on schooling.

An important issue is how generalizable our results are to other contexts outside of Nepal. Nepal is among the places frequently cited in discussions of menstruation and schooling (Jackie Kirk and Sommer 2006, WaterAid 2009), but policy efforts are also focused on Africa. While it is obviously difficult to generalize to other settings, there are many factors which are constant: low income, poor sanitary products, and cultural restrictions during menstruation. In addition, in our baseline survey 54 percent of girls report *ever* missing school due to their period; this is very similar to responses to similar questions in other contexts and, we argue, suggests that our setting looks very similar to other settings when we analyze comparable data. The major difference here is the fact that we can look in more detail at the absence patterns and actually quantify the effects.

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