Breaking down menstrual barriers in Bangladesh

Cluster RCT evidence on school attendance and psychosocial outcomes of adolescent girls

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ABSTRACT

Abstract

Girls' poor ability to manage menstrual health (MH) imposes barriers to education and general wellbeing, especially in low- and middle-income countries. This paper presents the results of the *Ritu* trial, a 2-year clustered randomized controlled trial, examining the effect of a multi-faceted menstrual health intervention in Bangladesh. We randomized 148 schools from one rural district, into one of three groups; i) receiving a school program (sanitation facilities, MH education and support); ii) a school program and a targeted household program (parental MH education); iii) or the control group. The primary beneficiaries are schoolgirls in grades 6 until 8, age 11-15. We measure short- to medium-term impacts on school attendance, a set of psychosocial outcomes, and menstrual health outcomes. We use three sources of school attendance data: information from administrative records; self-reported survey responses and data from spot-checks where someone from the research team would appear unannounced and on randomly selected dates at school to record attendance.

We find significant treatment effects in both treatment arms. The *Ritu* trial significantly improved menstrual health outcomes. Moreover, it significantly reduced school absence rates and reduced the likelihood of dropping out of school before grade 8. The program also improved psychosocial wellbeing and empowerment during menses, but this did not translate into substantial improvement of general wellbeing and empowerment. We find little evidence that the additional household program generated larger effects than the school program alone – which is important for programming purposes given the substantial additional costs of the household intervention. Our findings show the school program was considerably more cost-effective than the combined program, both when measured in 'additional years of schooling' and 'learning-adjusted years of schooling'.

Even though MH programs are becoming more prevalent, supporting quantitative evidence on their impact is very limited. We show a positive impact of a menstrual health program on school attendance and other psychosocial outcomes of adolescent girls.

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1 Introduction

Every month, 2 billion women[1] worldwide have to manage their period, and this often happens in a secretive and discrete manner. In high-income countries, a move towards more open dialogues and combatting 'period poverty' is gaining some traction. In 2021, the UK abolished taxes on sanitary products[2] and New Zealand provides all schoolgirls with Menstrual Health (MH) products for free[3]. Next to issues of 'period poverty' (the lack of access to sanitary products due to financial constraints) in many low – and middle- income countries (LMICs) women also face restrictive norms, social taboos, limited knowledge about menstruation and a lack of proper facilities and products for adequate menstrual health management. This marginalizes girls and women on their menses, excludes them from society and hinders their ability to carry out every day activities. In this study, we conduct a clustered randomized controlled trial in rural Bangladesh to examine the impact of a comprehensive menstrual health program aimed at tackling these challenges for menstruating girls and increase their school attendance, and general wellbeing.

Menstruation, and the beliefs and norms associated with it, can lead to serious barriers to education, health and personal development (Chandra-Mouli and Patel, 2017; Fakhri et al., 2012; Grant et al., 2013; Miiro et al., 2018; Sommer and Sahin, 2013; Sumpter and Torondel, 2013; Tegegne and Sisay, 2014). Girls often have their first menstrual period without knowing what it is, leaving them scared and ill-informed about practicing safe MH (Chandra-Mouli and Patel, 2017). Their female family members are the primary source of information, but they often lack proper MH knowledge themselves and live in a culture where menstruation is seen as dirty, infectious and shameful (Chandra-Mouli and Patel, 2017). Next to existing taboos surrounding menstruation, adequate MH products and water and sanitation facilities tend to be scarce and typically lack physical provisions for dealing with MH; lockable, single-sex, private toilets with clean water and soap for washing, a private open air

[1] *World Development Indicators 2017, total women in the age 12 (mean age menses) to 50 (mean age menopause)*

[2] *"Activists cheer as 'sexist' tampon tax is scrapped" https://www.bbc.co.uk/news/business-55502252, retrieved January 22nd 2021*

[3] *"Period poverty: New Zealand schools to offer free sanitary products" https://www.bbc.co.uk/news/world-asia-56107816, retrieved February 18th 2021*

space to dry wet cloths and a closed bin for used pads (Chandra-Mouli and Patel, 2017; Hennegan et al., 2017; Montgomery et al., 2016; Oster and Thornton, 2011; Sommer et al., 2015). Additionally, menstruating girls often face social exclusion, such as exclusion from touching water, cooking, attending religious ceremonies, attending school and socializing (Sumpter and Torondel, 2013). Moreover, girls report harassment by boys and teachers (Sumpter and Torondel, 2013; Tegegne and Sisay, 2014). Policymakers, implementers and researchers alike, have long overlooked how to improve menstrual health in LMICs. This is surprising, since MH is associated with at least six[4] out of the seventeen Sustainable Development Goals from the United Nations. Programs targeting MH have become more prevalent over the last few years and these programs range from software interventions (improving girls' knowledge, attitudes and practices) to hardware interventions (providing facilities and products needed for adequate MH).

Around the time of menarche, i.e. age 12-15, gender-based gaps in schooling in LMICs start to widen to the detriment of girls (Muralidharan and Prakash, 2017; Singh and Krutikova, 2017). Girls face many barriers to education, and menstruation is one of them. This is troublesome, since education plays a key role in the personal development and future earnings of adolescents, and improving girls' education can be a cost-effective ways of spurring this development (Muralidharan and Prakash, 2017; Tembon and Fort, 2008). Qualitative evidence suggests an association between educational outcomes and poor MH (Chandra-Mouli and Patel, 2017; Mason et al., 2013). Quantitative evidence on the link between MH and educational attainment is scarce and has led to mixed results, and research designs suffer from vague measures to quantify MH on the one hand and difficulties measuring school attendance on the other hand (Alam et al., 2017; Chandra-Mouli and Patel, 2017). Mixed methods studies combining both quantitative and qualitative designs in Uganda and Ethiopia, found menstruation to be strongly associated with school attendance (Miiro et al., 2018; Tegegne and Sisay, 2014).

[4] *Sustainable Development Goals; 1, 3, 4, 5, 6 and 10*

Lack of MH knowledge, practices and support is not only a barrier to education but also impedes psychosocial outcomes and personal development (Chandra-Mouli and Patel, 2017). Crichton et al. (2013) found that menstruation was associated with negative emotional and psychosocial aspects in Kenya and Miiro et al. (2018) found increased levels of embarrassment and fear of teasing in Uganda. A literature review by Chandra-Mouli & Patel (2017) concluded that poor MH practices are associated with a range of adverse psychosocial outcomes such as feelings of shame, anxiety, and distraction.

There is thus evidence on the detrimental effects of poor MH on the education and personal development of girls and women, yet evidence on the effectiveness of MH programs is scarce. A few studies on MH programs have been done, but they are mostly qualitative in nature or suffer from small sample sizes and weak identification strategies. It is unclear whether MH programs also directly influence health outcomes. A meta-analysis of mostly cross-sectional studies, showed no association between MH and health outcomes such as bacterial vaginosis or urinary infections (Sumpter and Torondel, 2013). Qualitative evidence suggests a link between improvements in MH outcomes and educational, psychosocial and empowerment impact, yet the quantitative evidence is scarce and it remains unclear if improvements in MH outcomes translate to impact on education and personal development of adolescent girls. An RCT feasibility study in Kenya found that provision of menstrual cups was associated with lower risk of sexual transmissible infections and bacterial vaginosis, but found no association with school dropout (Phillips-Howard et al., 2016). A systematic review by Hennegan and Montgomery (2016) looked at the effectiveness of MH programs providing either hardware interventions (providing menstrual resources such as sanitary pads) or software interventions (addressing psychosocial deficits) and its effect on educational and psychosocial outcomes, they conclude that there is insufficient evidence to determine the effectiveness of MH programs.

In the current study, we focus on Bangladesh, where 40% of girls reportedly miss three days of school during their menstrual period each month (Alam et al., 2017). In Bangladesh, much like other LMICs, menstruation is often regarded as polluted and

shameful and surrounded by myths, taboos and misconceptions (Ahmed and Yesmin, 2008; Haque et al., 2014). The evidence on poor MH and the effectiveness of MH programs in Bangladesh is scarce, and does not rely on rigorous research designs. Haque et al. (2014) studied the effects of a school-based educational intervention on MH outcomes in three schools in Bangladesh and found the educational program improved menstrual knowledge, beliefs and practices, but they did not study effects on educational or psychosocial outcomes. Regarding educational outcomes, Alam et al. (2017) used a cross-sectional survey to study MH risk factors affecting school absence of Bangladeshi girls, and concluded that the following factors played a role; misconceptions about menstruation, insufficient facilities at school, and restrictions imposed on menstruating girls. We are the first to examine the causal effect of an MH program on both MH outcomes, as well as educational, psychosocial and empowerment outcomes.

Several studies have stressed the gap in evidence for quantitative studies on the causal effects of MH interventions, and the need for more rigorous evidence especially for adolescent girls' school attainment. Our study addresses this gap in evidence and contributes by examining the effects of a menstrual health program on adolescent girls in Bangladesh. We conduct a clustered randomized controlled trial on the impact of the MH program called '*Ritu*' – coordinated by Simavi, a Non-Governmental Organization (NGO). The *Ritu* program is a multi-faceted program which improves MH knowledge, constructs MH-friendly toilet facilities at schools and stimulates a supportive environment for menstruating girls. Through these activities, *Ritu* aims to reduce barriers for menstruating girls to be included in society, attend school, and live a healthy life. The program aims to be inclusive and empower all girls with the knowledge, tools and support to partake in everyday activities whilst on their menses. Mothers, fathers and boys are also actively included in the intervention, since they play an important role in providing supportive environments. The majority of our sample lives just below or just above the international poverty line, and is growing up in an environment unfavorable to women. Improving MH knowledge, building toilet facilities and improving support systems for adolescent girls, could lead to higher school attendance and improved levels of psychosocial wellbeing and empowerment.

The *Ritu* program is designed based on evidence and a specific needs assessment in the target area. This led to the holistic nature of the program, in line with the growing acknowledgement that MH programs are more effective when targeting the whole MH system (schools, cultural beliefs, communities, toilet facilities) (Chandra-Mouli and Patel, 2017). The needs assessment, for example, identified that availability and costs of sanitary pads were not the main barriers towards MH in our study area (Newbury, 2015). This is consistent with the findings from Alam et al. (2017), who found that the use of sanitary pads was uncommon and not associated with school attendance in Bangladesh. In many other settings and MH programs, poverty plays a role when girls cannot afford the sanitary products recommended by the program. Even in high-income countries, poorer females sometimes struggle to afford the relatively expensive sanitary products, but the setting in rural Bangladesh is very different. The prices of sanitary products are relatively low, and cannot be compared to (the heavily taxed) prices of sanitary products in high-income countries. Moreover, Alam et al. (2017) studied MH risk factors in Bangladesh and also concluded that wealth was not a risk factor. Rather, they found that risk factors included girl's attitude, misconceptions about menstruation, insufficient and inadequate facilities at school, and restrictions imposed by family. The Ritu program tackles all of these channels.

Next to measuring the impact of the *Ritu* program, we also examine its cost-effectiveness. We calculate the educational impact generated per treatment arm, per dollar spent on the program. For this analysis, we focus on educational outcomes only and not on the softer outcomes such as psychosocial wellbeing and empowerment. Years of schooling and school attendance are standard outcome measures in CEAs (Buchmann et al., 2018). Much of the CE literature in development focuses on education since the outcomes are more objective, easily quantifiable, and can be compared across countries. We therefore use the standard cost-effectiveness measures of school attendance and years of schooling. Next to those traditional measures, we use a relatively new benchmark for measuring the impact on education levels: Learning-Adjusted Years of Schooling (LAYS). The LAYS is a measure recently introduced by the World Bank to adjust for different levels of educational quality

between countries (World Bank Group, 2018). Since the literature on the cost-effectiveness of MH program is limited, we compare our CE findings to educational programs in general.

Our results show that the *Ritu* program significantly reduced the school absence rate of girls with a range of 8.8 - 29% in the school program (T1) and 12.2 -19% in the combined program (T2). We are the first to examine the effect of an MH program on boy school absence rates, and found a reduction in school absence rates in both the school program and the combined program. We also find a large treatment effect on menstrual health outcomes, and improvements of psychosocial wellbeing and empowerment of girls during their menses. We find no substantial improvements in general levels of psychosocial wellbeing and empowerment. For most outcomes, we do not find a significant additional benefit of the combined program over the school program.

Our cost-effectiveness findings show that for every $1000 spent on the *Ritu* school program, 1.51 additional years of schooling were realized (or 0.89 learning-adjusted years of schooling). The school program (T1) was more efficient at increasing school attendance than the more comprehensive program that also includes a household component (T2). In the combined program (T2), an additional $1000 led to an increase of 0.56 years of schooling (or 0.33 learning-adjusted years of schooling). These findings lie within the range of the limited evidence on CE of educational programs in Bangladesh (Buchmann et al., 2018; Hahn et al., 2018; Hong, S. Y., & Sarr, 2012). The total impact of a program is an important outcome for calculating the CE of a program, and it relies on i) the impact of the program per beneficiary and ii) the total number of beneficiaries. We took a conservative approach to estimating these two components, because of two reasons. First, regarding the impact, due to data limitations we only included impact on school attendance and not on school dropout, even though the program significantly reduced dropout rates. Second, regarding the total number of beneficiaries, we only included girls who were in school during program implementation and did not include boys or future cohorts benefiting from the program. The CE estimates are thus best interpreted as a lower bound of cost-

effectiveness of the *Ritu* program, the long-term cost-effectiveness is likely to be higher.

This is the first large-scale clustered RCT on a multi-faceted MH program. This study contributes to the limited current evidence base of MH programs by evaluating a comprehensive intervention and quantitatively measuring outcomes related to menstrual health. Additionally, we are the first to examine the value of adding a targeted household component to a school-level MH program. We also contribute to the cost-effectiveness literature, by examining the cost-effectiveness of the program both with a traditional measure (years of schooling) and a relatively new measure; the learning-adjusted years of schooling.

This paper is structured as follows: in section 2 we provide more background to the program and expected outcomes. In section 3, we describe the methods and section 4 describes the results. Section 5 describes the heterogeneity analyses, and section 6 the cost-effectiveness analysis. In section 7 we discuss the results, and section 8 concludes.

2 Background

2.1 The Ritu program and expected outcomes

The *Ritu* program aims to reduce menstrual barriers to education, health and personal development of adolescent girls, in an inclusive way. The program was implemented in a rural district in northern Bangladesh. The dominant menstrual barriers in the study setting are intertwined but can broadly be categorized in three domains; i) lack of MH-friendly toilet facilities at school, ii) limited MH knowledge and prevailing restrictive MH beliefs and expectations and iii) limited MH support systems. By reducing the menstrual barriers, the program aims to empower adolescent girls with the tools, knowledge and support they need to manage their MH. This in turn, is expected to improve MH outcomes and lead to improved educational outcomes and raise psychosocial and empowerment outcomes. See Sol et al. (2019) for a detailed description of the design of the *Ritu* program.

The *Ritu* program was led by Simavi and implemented by its local partners (BNPS, DORP and RedOrange[5]) from 2017 until 2019. The *Ritu* trial is a clustered RCT with three treatment arms; (T1) schools receiving a school program; (T2) schools receiving a school program combined with a targeted household program ('combined program'), and (C) schools with no intervention ('control group').

The school program consisted of, i) extensive launch campaign to familiarize teachers, students and parents, next to festivities, it included discussion groups, essay writing competitions and screening of a MH tv-show, ii) construction and maintenance of MH-friendly toilet facilities at school, iii) incorporating puberty- and MH-modules in the school curriculum, vi) stimulating a supportive MH-environment at school through extra-curricular activities such as student discussion groups. Additional to the school program, T2 schools also received the targeted household program where parents (or guardians) of the school girls received 2-day sessions to increase MH knowledge and understanding of the benefits of safe MH. In these sessions, there was an emphasis on the role parents play in providing their menstruating daughters with the tools and support they need to practice safe MH and partake in daily activities. All these components together, address the main menstrual barriers adolescent girls are facing in this study setting; lack of facilities at school, lack of knowledge and lack of support.

The program is expected to influence the MH outcomes of girls since they now have better facilities, knowledge and support in managing their menstruation. Additionally, menstruating girls might attend school more frequently, since schools now have MH-friendly facilities, teachers and pupils better understand and support managing MH at school, and parents are more likely to allow menstruating daughters to attend school. This latter effect, is expected to be stronger in T2 where parents are directly targeted with a household intervention. Next to educational outcomes, the program is likely to affect psychosocial and empowerment outcomes. Adolescent girls are in a state of physical and social transition, they are in puberty and quite vulnerable.

[5] *RedOrange also worked on another component of the Ritu program, which was not implemented in our study area and therefore is out of the scope of this study*

Actively including menstruating girls in society, addressing their concerns and fears about MH, and promoting equal treatment of boys and girls is expected to improve their psychosocial wellbeing and empowerment levels. These effects on adolescent girls, are the main aim of the *Ritu* program. However, boys are an important part of the MH support system of girls and thus were also targeted by the school-based interventions. They are in the same class as the girls, and received the same puberty and MH education lessons and were also assigned an active role in the school pupil committees. Boys may have benefited from the improved toilet facilities at school, MH education classes (which included topics such as boy puberty) and a more supportive environment at school, which might increase their motivation to come to school. Unlike for girls, 'lack of interest' is the third most cited reason for skipping school amongst boys in Bangladesh (Subrahmanyam, 2016), we might thus find modest effects on the school attendance of boys.

The comprehensive nature of the *Ritu* program affects many aspects of the lives of girls and to a certain extent also boys. We therefore expect[6] to see outcomes in several categories; MH outcomes, educational outcomes, psychosocial and empowerment outcomes. Next to examining the effect of the *Ritu* program on our main variables of interest, we also assess if the program was inclusive. The program was designed so that every girl would be equipped with the knowledge, tools and support to manage her menstruation. Still, the effects of the intervention could depend on pre-program levels of poverty, psychosocial wellbeing, empowerment, and household composition. We therefore also investigate heterogeneity of program effectiveness across these sub groups.

2.2 Intervention component details

A key feature of the school program is the construction of MH-friendly toilet facilities at schools. These facilities are realized at schools, via a process called 'budget-tracking'. The process ensures ownership and sustainability, by activating school management to claim the water and sanitation budget available at local government

[6] The research team and project team laid out all hypotheses and registered this RCT-study at the AEA RCT Registry[6], which includes a Pre-Analysis Plan listing expected outcomes (archived on December 6, 2017). A supplement to the plan listing all research hypotheses with corresponding outcome groups, was archived on June 3rd, 2019 prior to end line data analysis.

bodies[7]. In total, 10.3 million BDT (120,000 USD) was mobilized to construct or upgrade school toilet facilities to gender-separated MH-friendly facilities with locks, lights, bins, soap and running water.

After the facilities had been built, pupils received MH lessons to address lack of knowledge of biological processes during puberty, tools to use for MH, and prevailing MH beliefs and expectations. The MH modules were developed to fit in well with the national curriculum in Bangladesh, a curriculum which usually lacks topics on adolescence and menstrual health (Alam et al., 2017). Teachers received a five-day training, focused on menstrual education for themselves, didactical skills and incorporation of the MH module in lesson plans, with a specific focus on how to teach culturally sensitive topics. Teachers received tailored and ongoing support from staff during monthly visits, on-demand support, and quarterly meetings with teachers from other schools, as well as a two-day refresher training. The menstrual modules also covered topics on puberty in general (for both boys and girls) and were taught in the classrooms of grade 6 until grade 8, to both girls and boys. The module was taught at least twice a month. Additionally, a reduced version of this MH module (with only visual information) was used in the household intervention. More information on the development and distribution of the module can be found in the study protocol by Sol et al. (2019). In total, more than 1,000 teachers (75% male, 25% female) were trained, and they taught more than 4,000 MH lessons over the course of the program.

Next to building MH-friendly toilet facilities, and increasing MH knowledge, the *Ritu* program specifically focused on inclusion and providing a sustainable and supportive environment at school. This started at the highest level, with school management actively involved in the 'budget-tracking' process and construction of toilet facilities. Next, instead of training only the 2-3 teachers who actually taught MH lessons in class, at least 10 teachers per school and the headmaster were trained. This is to ensure an environment where teachers also receive the support and understanding they need from their colleagues, to be able to teach a (perceivably) sensitive topic such as MH. On the pupil level, lessons were purposely given to mixed-gender classes, to

[7] *The local engineering department and, Union and Upazila Parishads.*

normalize menstruation and transitions during puberty for both girls and boys. In these classes, the role boys play in creating supportive environments for girls, was emphasized. At every school, pupil committees were formed with 50% girls[8] and 50% boys. The committees actively participated in keeping the toilet facilities clean and MH-friendly, and offered peer-to-peer support on a range of adolescent topics.

Schools in T2 received a targeted household program, in addition to the school program. The household program explicitly targeted all parents and/or guardians of grade 6-8 girls in treatment schools. A member of the implementing NGO invited parents to attend 'parent sessions', held in their community. In these sessions, fathers and mothers received separate lessons on MH, similar to the MH module taught to their daughters in school. The sessions were gender separated to encourage an open dialogue and also to be able to address gender-specific knowledge gaps. The two-day sessions covered general biological lessons about puberty of boys and girls, MH knowledge, attitudes, and practices and ways to support menstruating girls. It challenged prevailing traditional beliefs surrounding menstruation, and the role parents can play in making sure their menstruating daughters are included, and partake in every-day activities such as coming to school. In total, more than 4,500 mothers/guardians attended the sessions and 4,500 fathers/guardians.

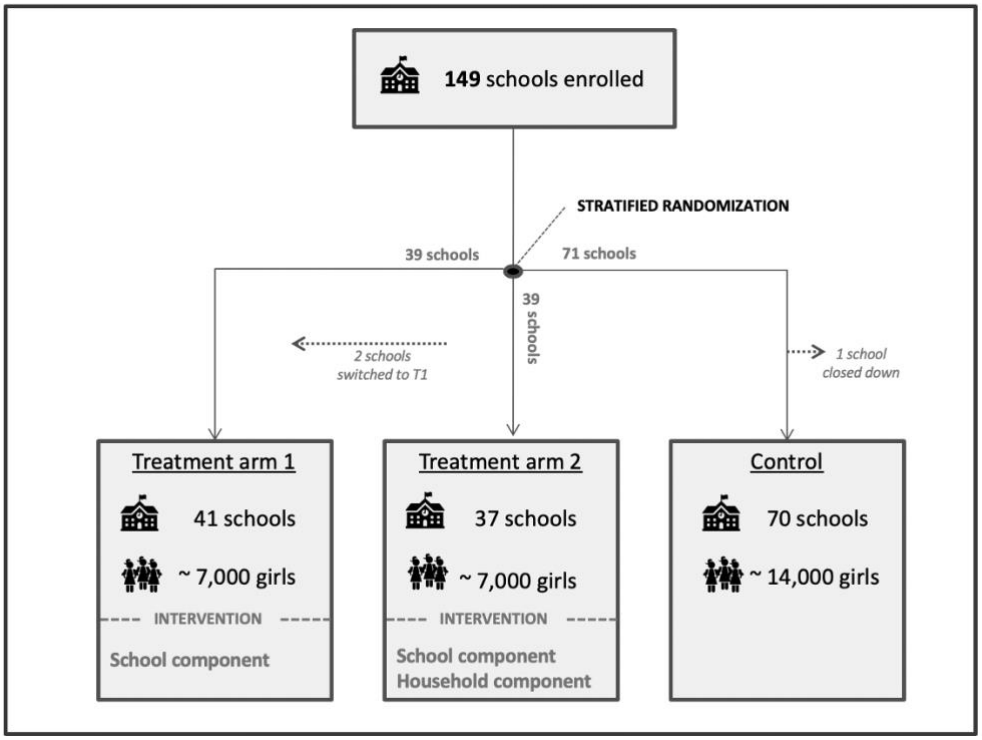
In sum, the *Ritu* program has a multi-faceted and inclusive approach, the different components complement each other and jointly affect a range of outcomes.

[8] *Girls who have had their menarche*

3 Methods

3.1 Study design

FIGURE 1
Flow Diagram of *Ritu* clustered RCT evaluation



We conduct a cluster randomized impact evaluation of the *Ritu* program using a sample of 148 schools in a rural district in northern Bangladesh. All mixed-gender junior secondary schools in the district were eligible for the program. Junior secondary schools teach grades 6 until 8 and the average age of pupils is 11-14 years. We used pilot data collected by our implementing partner on 8 schools in the district, to perform a stratified randomization. The unit of randomization is the school, and we stratified by sub-district[9], school attendance rates, and quality and quantity of toilet facilities at school. More detailed information regarding the stratified randomization can be found in Sol et al. (2019). Figure 1 shows the flow diagram with the final allocation[10] of 41 schools in T1; 37 schools in T2 and 70 schools in the control group.

[9] *Named: Upazila*

[10] *After detailed mapping, we found that two of the T2 schools catchment areas were too close to the catchment areas of T1 schools (meaning, there were a few communities where girls from T2 schools resided, as well as T1 schools. To avoid unwanted spillover effects of the household component of T2 (which is delivered at community level), we cancelled the household components of those T2 schools hence they are now T1 schools (receiving only the school component, and not the household component). In the control group, one school was closed down.*

Table A - 1 in the appendix reports the randomization check of pre-program differences for a variety of school characteristics per treatment group. We performed Kruskal-Wallis tests for differences between treatment arms, and found no statistically significant mean differences.

3.1.1 Sample

Our sample consists of girls who just started junior secondary school at baseline (grade 6) since they are the main target group of the *Ritu* program. We ran power calculations to determine the appropriate sample size per cluster (i.e. school), and separate sample size calculations[11] for our primary educational outcome. We used information from our pilot mapping study with 8 schools in the district. We specified the following parameters: repeated measures with two data collection rounds, taking the 3-level nature of the data into account (Level 1: schoolgirls; Level 2: schoolgirls clustered into time (baseline, endline); Level 3: schoolgirls clustered into time are clustered into schools). We used an alpha of 0.05, and ran different scenarios based on previous literature (Hennegan and Montgomery, 2016; Wilson et al., 2014) with the following options: an expected effect size of 0.2 or 0.3 and an intracluster correlation of 0.1 or 0.3 (Wilson et al., 2012). This led to a sample size of at least 25 girls per school, without attrition. Using a common rate of anticipated attrition of 10%, our sample size for the baseline survey is 28 girls per school and 4172 girls in total. Some schools had less than 28 girls per grade, therefore the final sample size at baseline was: 3862 girls.

3.1.2 Outcomes

Our primary impact outcomes are; educational outcomes, psychosocial outcomes and empowerment of adolescent girls. Our secondary outcomes are MH outcomes, such as MH practices, attitudes, and communication. Table 1 provides an overview of the main outcomes, the data sources used and the timing of data collection. Table A - 2 shows a detailed overview of all outcomes and subdomains of outcomes. Most outcomes are measured through surveys of a subset of girls who were at the start of grade 6 at t=0 and grade 8 at t=2. School attendance data is collected on a rolling basis,

[11] *using the open-source software program Optimal Design (3.01)*

and is a triangulation of three data sources: spot-check data, administrative school records and self-reported school attendance in surveys.

TABLE 1
Overview main outcomes, data sources and timing

	Data source	**Data timing**
Educational outcomes		
School attendance girls and boys	School records	Rolling basis
School attendance girls	Spot-check	Rolling basis
School attendance girls	Survey	Baseline & endline
Psychosocial outcomes	Survey	Baseline & endline
Empowerment outcomes	Survey	Baseline & endline
Menstrual Health outcomes	Survey	Baseline & endline

3.2 Data

We used three methods for collecting quantitative data: surveys, spot-check school attendance data, and administrative school records.

3.2.1 Survey data

The baseline survey took place at the start of the academic year in February and March 2017, and the endline survey in March and April 2019. The surveying was executed by the independent survey firm 'Capacity Building Service Group' (CBSG). The whole team from CBSG was blinded to treatment conditions. Only female enumerators were allowed on this project, as the survey contains sensitive gender-related topics. In every school, a random selection of 28 girls from grade 6 were asked[12] to partake in the survey. This selection was done during a game in class, where every girl blindly picked a marble out of an opaque bag filled with 28 green marbles (survey takers), 2 red ones (replacement) and black (no survey). Headmasters signed informed consent, and girls were privately briefed and after their consent, the surveying was conducted in a private setting. The enumerators were extensively trained by our team to adhere to the script and to make the girls feel comfortable during the 60-minute survey. The survey was first designed in English, then translated into the local language Bengali and back-translated into English for cross-checking. The surveys were administered

[12] *Only one girl refused to partake in the survey and was replaced*

on Android tablets with the use of some props such as little dolls, and data was safely stored on a local server on a daily basis. The total enumeration team consisted of a project manager, a field manager, an ICT manager, 6 field supervisors and 30 enumerators.

3.2.2 School data

Measuring education (in terms of school absence) can prove to be challenging in low-income settings, where school records are often classified, not digitalized and prone to inaccuracies. Survey questions on school absence on the other hand, can suffer from recall bias and self-reporting bias. We collected school data in three different ways: self-reported survey data (as described above), spot-check data collected by an independent research team and administrative school record data. The latter contains information on daily attendance rates of all pupils. These records however, are highly prone to inconsistencies, amongst others due to financial incentives for school staff and parents to report high attendance rates. For example, girls receive stipends if their recorded annual attendance is 75% or higher[13]. On the other hand, administrative school records do contain valuable information on year-round attendance rates, even though the data might be noisy. Therefore, we collect administrative school records twice a year, focusing on aggregate monthly attendance rates per grade and gender, and individual attendance rates of our subset of surveyed girls. The chances of having inconsistencies in the school records are highest near the end of the school year, when school records are aggregated and reported to local educational authorities. Therefore, we collected school record data every 6 months (twice a year) and well before the end of the school year to mitigate the risk of inconsistent data as much as possible.

While school records can be an efficient way of gathering school attendance data, previous literature has stressed the higher quality of researcher collected unannounced spot-checks for collecting school attendance data (Miguel and Kremer, 2004; Muralidharan and Sheth, 2016). Unannounced independent spot-checks, have the potential of overcoming issues with misaligned incentives, self-reporting bias and

[13] *In Bangladesh, the Female Secondary School Stipend Program was launched nationally in 1994 and pays tuition-fees and provides monthly stipends for unmarried rural girls up to grade 10 who attend recognized institutions, remain unmarried, maintain at least 75% attendance, and secure at least 45% marks in the annual examinations (a pass requires 35%).*

recall bias. Those issues are often associated with methods such as interviews, student diaries or school records. Therefore, next to using school records and survey data, we also gathered high-quality spot-check data on school attendance. This data was collected by an independent research team, with ethical approval of all local authorities and headmasters. The spot-checks were unannounced and happened approximately once a month. The data collection process was designed to be as little disruptive as possible.

3.3 Analysis sample

There are several sources of missing data between our sample of 3862 grade 6 girls at baseline, and the final sample we can use for our impact analysis. First, 354 girls could not be tracked for the endline survey, mostly[14] due to migration outside of the study area. This led to an attrition rate of 9% which is common in this type of longitudinal study and context (Millán and Macours, 2019). We checked, and attrition does not appear to be systematically related to treatment status or observable co-variates. Second, 668 girls did not receive full treatment because they left their school. These 668 girls either dropped out of school entirely (376 girls) or migrated to another school outside the implementation area (292 girls). Third, 725 girls did not have their menarche during the implementation of the *Ritu* program. These girls were thus not fully treated, and excluded from the main analysis. The final analysis sample comprises 2127 girls: 595 girls in treatment 1, 570 girls in treatment 2 and 962 girls in the control group. For the analysis of educational outcomes, the analysis sample is further reduced to 1985 girls due to inconsistent or insufficient school attendance data from the school records or spot-check data.

	TREATMENT 1	**TREATMENT 2**	**CONTROL GROUP**	**TOTAL**	**TOTAL (SCHOOL ATTENDANCE ANALYSIS)**
Analysis sample	595 girls	570 girls	962 girls	2127 girls	1985 girls

[14] *Migration to another district was the main reason; mainly due to work in the clothing industry in Dhaka, marriage or household moved away.*

3.4 Empirical Strategy

We evaluate treatment effects for each outcome using the following model:

$$Y_{ij} = \beta_0 + \beta_1 \text{Treatment I}_j + \beta_2 \text{Treatment II}_j + \beta_3 X_{ij} + \varepsilon_{ij} \qquad (1)$$

Where Y_{ij} is the outcome of girl i in school j at endline; Treatment I_j and Treatment II_j are treatment dummies, equaling 1 if girl i is in treatment 1 or treatment 2, respectively and 0 otherwise; and X_{ij} is a set of control variables. Even though we have a balanced randomized sample, we add several individual controls and adjust for stratification. We report both naïve standard errors corrected for clustering at school level, and Hochberg correct p-values that adjust for multiple hypothesis testing. The parameters of interest are β_1 and β_2; the intention-to-treatment effects.

We estimated the impact of the program on several outcomes, which increases the chance of a Type I error: falsely rejecting the null hypothesis even when the null is true. We address this issue of false discovery rate in two distinct ways. We either collapse homogenous outcomes into one index allowing for an individual test, or we report the Hochberg corrected p-values on a group of outcomes. This Hochberg method is a conservative way of correcting for multiple outcome testing (Hochberg, 1988).

4 Results

4.1 Program effects: lowering menstrual barriers

First, we examine if the *Ritu* program was well executed and successfully reduced barriers to practicing safe menstrual health and attending school whilst on menses. Specifically, we examine the effects of the intervention on i) menstrual knowledge, ii) MH-friendly toilet facilities at school, iii) MH supportive environment, iv) MH beliefs and expectations.

4.1.1

4.1.2 Menstrual knowledge and MH-friendly toilet facilities at school

In general, our results show the program was well executed. The use of the MH module led to an increase in the knowledge of girls about menstruation and menstrual

health. Table 2 shows the regression results. Throughout our analyses, we report regression results both with and without control variables. Despite the randomized nature of the experiment, we control for several baseline characteristics including household characteristics and our stratification variables to improve the precision of our estimates. All robust standard errors are clustered at school level, and reported in parentheses. Throughout our analyses, we report the coefficients on treatment 1 and treatment 2, and also report the control mean: the mean value in the control group of the relevant dependent variable.

We find that MH test scores are significantly higher in both treatment groups (column 1). Part of the *Ritu* program, is the construction of MH-friendly toilet facilities at schools by an NGO, and the maintenance by the school itself. The girl-to-toilet ratio is 38 in the control group, and significantly lower in both treatment arms (Column 2, Table 2). Concerning the MH-friendliness of toilets, girls in the treatment groups were significantly more likely to report the toilets had soap, a bin, water inside, light and were clean. We do not find any significant differences in school toilet characteristics between the two treatment arms (see p-values of WALD tests for equality of coefficients reported in Table 2), which is in line with expectations since both treatment arms received the exact same school program.

TABLE 2
Program effects: MH knowledge and school toilet characteristics

	MH KNOWLEDGE	SCHOOL TOILET CHARACTERISTICS					
		GIRL TO TOILET RATIO	SOAP	BIN	WATER INSIDE	LIGHT	CLEAN
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
T1: School program	0.461***	-7.552***	0.830***	0.661***	0.316**	0.180*	0.520***
	(0.142)	(2.781)	(0.138)	(0.118)	(0.133)	(0.092)	(0.171)
T2: School + HH program	0.559***	-6.815**	0.884***	0.663***	0.358***	0.145*	0.334*
	(0.130)	(2.862)	(0.130)	(0.118)	(0.130)	(0.085)	(0.177)
Control mean	6.44	38	2.00	2.33	2.38	2.15	1.7
p-value T1=T2^	0.508	0.816	0.600	0.934	0.734	0.741	0.345
Observations#	2,095	143	143	143	143	143	143
School Controls^^	YES	YES	YES	YES	YES	YES	YES
Indiv. Controls^^	YES	NO	NO	NO	NO	NO	NO

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. Hochberg corrected p-value adjusts for multiple hypothesis testing. Dependent variables: MH knowledge (0-9), Toilet-to-Girl ratio is the ratio of total girls enrolled in school over the amount of functioning school toilets, all other dependent variables of school toilet characteristics are categorical (1=No 2= Sometimes 3=Yes) *** p<0.01, ** p<0.05, * p<0.1. # Observations: 5 schools had no school toilets, therefore the sample size for the school toilet characteristics is 143 instead of 148 schools. ^'p-value T1=T2' tests for equality of coefficients, with the null hypothesis $\beta_{t1} - \beta_{t2} = 0$. ^^School controls in each regression include: stratification variables and school size at baseline. Individual controls include: age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), number of female role models in household.*

4.1.3 Normative beliefs and expectations

Next, we examine if the *Ritu* program has led to changes in restrictive normative beliefs and expectations about menstruating girls. Restrictive beliefs surrounding menstruating girls are a great barrier to safe MH and actively participating in society (e.g. attending school). Table 3 presents the results on girls' beliefs. For example, 90% of girls in the school program believed a girl should not avoid going outside when menstruating versus 82% in the control group. For our analysis, we used the index score of five activities (going outside, being around men, cooking, playing and eating 'white food[15]'. Table 4 shows the regression results of the index score. We find a significant and positive effect of both treatment arms. The regression coefficients suggest the program successfully lowered restrictive beliefs surrounding the mobility of girls on their menses.

[15] *'White food' is a common term in this research context, literally meaning food that is white. Such as milk, eggs, or bananas.*

TABLE 3
Descriptive statistics: girl's normative belief and expectations

	GIRL'S NORMATIVE BELIEFS		
	T1	**T2**	**Control**
	% I disagree	% I disagree	% I disagree
A menstruating girl should avoid:			
Going outside	90%	92%	82%
Being around men	79%	84%	70%
Cooking	92%	93%	85%
Playing	84%	83%	69%
Eating white food	87%	89%	64%

TABLE 4
Program effects: girl's normative MH beliefs and expectations

	(1)
	GIRL'S NORMATIVE BELIEFS
T1: School program	0.118***
	(0.023)
T2: School + HH program	0.140***
	(0.022)
Control Mean	0.75
p-value T1=T2^	0.327
Observations	1,983
Controls^^	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variable: index score of agreement with 5 restrictive normative beliefs; ranging from 0 (agrees with all 5 restrictive beliefs) to 5 (disagrees with all 5 restrictive beliefs) ^'p-value T1=T2' tests for equality of coefficients, with the null hypothesis* $\beta_{t1} - \beta_{t2} = 0$. *^^ Controls include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), number of female role models in household.*

4.1.4 Supportive environment for menstruating girls

The supportive environment plays an important role for an adolescent girl to manage her MH and come to school during menses. Many factors together create a supportive environment, and we quantitively measured four factors; MH understanding of boys, prevalence of teasing about MP, teacher's permission to use the toilet when asked and the provider of menstrual materials for use at school.

TABLE 5
Descriptive statistics: supportive environment outcomes

VARIABLE	DETAILS	TREATMENT I	TREATMENT II	CONTROL
Supportive environment				
Girls feel boys understand MH	% yes	100%	97%	47%
Toilet permission teacher (range 1-4)	Mean	3.7	3.7	3.5
Freq. teased about MP (range 1-4)	Mean	1.02	1.02	1.00
Provider of menstrual material for school:				
Self	% yes	51%	43%	69%
Family member	% yes	38%	47%	30%
Teacher	% yes	11%	11%	0%

Girls across all three treatment arms did not report any teasing about MP. On a scale from 1-4, the mean was 1 (never teased about MP) and we find no treatment effects (column 1, Table 6). We find strong evidence that the program increased boys' understanding of MH (column 2). In the control group, only 47% of girls have the impression that boys in school understand what MH is, compared to a full 100% in the school program and 97% in the combined program (see Table 5). Moreover, girls in treated schools were more likely to get permission to go to the toilet when they asked their teacher (column 3). Regarding the provider of menstrual material, we asked if girls had to provide the material themselves, a family member or if it was provided by a teacher. In the control group, 69% had to provide material themselves, 30% received help from a family member and only 0% said their teacher provides it. In the school program, 51% provides it themselves, 38% by a family member and 11% by the teacher. In the combined program, family members are even more likely to provide the material with 47% providing the material and again 11% reporting their teacher provides material (Table 5). Even though providing menstrual materials was not part of the *Ritu* intervention, treated schools often created their own distribution system. This explains why we find that 11% of the girls received their school menstrual material from a teacher.

TABLE 6
Program effects: MH support at school

	TEASING ABOUT MP	BOYS UNDERSTAND	TOILET PERMISSION	PROVIDER MENSTRUAL MATERIAL
	(1)	(2)	(3)	(4)
T1: School program	0.007	0.522***	0.168***	0.279***
	(0.007)	(0.060)	(0.046)	(0.056)
Hochberg corrected p-value	*0.342*	*<0.001****	*<0.001****	*<0.001****
T2: School + HH program	0.008	0.506***	0.136***	0.358***
	(0.009)	(0.064)	(0.043)	(0.057)
Hochberg corrected p-value	*0.353*	*<0.001****	*0.003****	*<0.001****
Control mean	1.00	0.47	3.54	0.31
p-value T1=T2^	0.888	0.492	0.475	0.263
Observations	2,095	148	143	1,972
Controls^^	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. Hochberg corrected p-value adjusts for multiple hypothesis testing. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: 'Boys understand' is a binary variable equally 1 if girl feels that boys understand what MH is and 0 otherwise. Toilet permission by teacher ranges from 1 (very unlikely) to 4 (very likely), for this variable we used the average answer per school, since this question is at school level and not individual level. Five schools in the control area had no school toilets at all, therefore the observation size is 143 for this outcome. 'Provider menstrual material' is a categorical variable, 0 (girl herself) 1(family member) 2 (teacher); Teasing about MP ranges from 1 (never teased) to 4 (almost always). ^ 'p-value T1=T2' tests for equality of coefficients, with the null hypothesis $\beta_{t1} - \beta_{t2} = 0$. ^^Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

4.2 Education

The results so far, provide evidence that the *Ritu* program was well-executed and succeeded in lowering certain MH barriers for girls. Now, we turn to examining how the lived and wellbeing of adolescent girls was affected by this lowering of MH barriers. We start with analyzing the effect of the intervention on school attendance, an outcome critical for the development of adolescent girls. Moreover, attending school during menses is a good way of measuring if menstruating girls are accepted in society and actively participating.

4.2.1 Descriptive statistics and method

We examine school absence rates using three sources of data: survey data, school records and spot-check data. These three data sources all have their advantages and disadvantages and measure school absence in separate ways. Therefore, we will continue to report on all three methods and do not collapse them into one measure. In order to be able to compare the different data, we calculated average school absence rate per observation, per method.

In Bangladesh, the school year generally consists of 37, 6-day weeks (222 schooldays). However, schools routinely lose 45 days a year due to administrative purposes and institutional demands. In case of heavy floods, this number can rise up to 140 closed school days per year (UNESCO-IBE, 2011). This makes estimating individual school absence rates challenging; we cannot simply count the number of days a pupil was absent, since the school might have been closed entirely and this should not count towards individual absence rates.

Throughout our analyses, we have corrected for the amount of open school days. We documented precisely how many days a school was open for all 148 schools in our study and estimated absence rates as follows:

School records: $$absence\ rate_i = \frac{No.absent\ days_i}{No.open\ school\ days_j} \quad (2)$$

Survey: $$absence\ rate_i = \frac{Self\ reported\ no.absent\ days_i}{No.open\ school\ days_j} \quad (3)$$

Spot − check: $$absence\ rate_i = \frac{No.absent\ during\ spot\ check\ rounds_i}{No.total\ spot\ check\ rounds_j} \quad (4)$$

Absence rates are calculated on the individual level for all 1943 schoolgirls *(i)*, and open school days are calculated per school *(j)*.

In June 2018, the *Ritu* program was fully implemented and every beneficiary had been covered by every component of the multi-faceted program. This means that schools had MH friendly toilet facilities, pupils have received at least six MH classes at school, and in treatment arm II, every household has had at least one MH education session. We therefore use school data from the 2018 school year, with an average of 177 open school days in our sample. Our sample of girls was in grade 6 at baseline, and in grade 7 during the 2018 schoolyear. In general, annual absence rates are quite high; depending on the method we used for measuring school absence; it ranges from 14.7% to 49.2%, see Table 7. All three datasets show the same trend: school absence rates are significantly lower for girls in treatment arms than in the control group.

TABLE 7
Descriptive statistics: school absence data girls

VARIABLE	DETAILS	CONTROL	T 1	T 2	P-VALUE*
School absence rate	Survey data	16.3%	13.1%	13.8%	0.00
	School records data	35.9%	25.7%	28.4%	0.00
	Spot-check data	52.5%	47.8%	45.2%	0.00
No. observations	Girls in grade 7	893	554	538	
No. of schools		70	41	37	

** Kruskal-Wallis test for differences between treatment arms, with ties*

4.2.2 Results: general school absence rates

We find strong evidence that girls came to school more often due to the *Ritu* program. The absence rates in treatment schools are significantly lower than in the control schools. Table 8 shows the regression results on school attendance for all three data sources. Columns (1) and (2) present results for the school records data. The school program reduced absence rates with 28.7% (10.3 ppts) compared to the control group, and the combined treatment reduced absence with 19% (6.8ppts). Columns (3) and (4) show the results using the survey data, where girls in the control group were absent 16.3% of the time. Here, we find that girl absence rates were 20.9% (3.4ppts) lower in the school program compared to the control group, and 13.5% (2.2ppts) in the combined program. Using the spot-check data, we find a treatment effect size of 8.8% (4.6ppts) for girls in the school program (column 5) and 12.2% (6.4 ppts) in the combined program (column 6). All results are robust to the conservative Hochberg correction of multiple outcome testing. All three data sources show similar results. The *Ritu* program successfully decreased girl school absence significantly, and there is no significant difference between the school program and combined program. We thus do not find evidence that the combined program is more effective than the school program in reducing absence rates.

TABLE 8
School Records, Spot-check and Survey data on school absence of grade 7 girls

School Absence Rates

	School records		Survey		Spot-check	
	(1)	(2)	(3)	(4)	(5)	(6)
T1: School program	-0.102***	-0.103***	-0.032***	-0.034***	-0.048	-0.046
	(0.025)	(0.024)	(0.009)	(0.009)	(0.032)	(0.031)
Hochberg p-value		*<0.001****		*<0.001****		*0.134*
T2: School + HH program	-0.075**	-0.068**	-0.025*	-0.022*	-0.073**	-0.064**
	(0.030)	(0.029)	(0.014)	(0.013)	(0.033)	(0.032)
Hochberg p-value		*0.063**		*0.086**		*0.067**
Control Mean	0.359	0.359	0.163	0.163	0.525	0.525
p-value T1=T2^	0.388	0.242	0.603	0.336	0.464	0.587
Observations	1,985	1,957	1,985	1,957	1,985	1,957
Controls^^	NO	YES	NO	YES	NO	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. Hochberg corrected p-value adjusts for multiple hypothesis testing. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: school absence rates of girls in grade 7, calculated using school records data in columns (1) and (2), survey data in column (3) and (4) and spot-check data in column (5) and (6). ^ 'p-value T1=T2' tests for equality of coefficients, with the null hypothesis* $\beta_{t1} - \beta_{t2} = 0$. *^^Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

4.2.3 Results: school absence during menses

Table 8 showed the treatment effect on general girl school absence rates. We compared the general absence rates across the treatment groups, and showed the menstrual health program reduced absence rates of girls who have had their menarche. Girls in treatment schools thus came to school more often, but we want to examine if they came to school more often in general or mostly during their menstrual days. We examine this in two ways. First, we run the same analysis on school absence rates, but this time for girls who have not had their menarche (yet). If the program raised general school attendance (beyond menstrual days), we would expect to see this effect also in pre-menarche girls. Second, we examine the channel directly by analyzing the answers to the survey question: "How often do you miss school due to being on your period?".

Our sample of 3862 girls contained 362 girls who did not have their period yet at endline. We run the same regressions as in Table 3, and examine if the *Ritu* program had a significant effect on the school absence rate of pre-menarche girls. We find no significant treatment effect of the *Ritu* program on the school absence rates of these

girls. Table A - 3 in the appendix shows the results per treatment arm, using all three school data sources. We thus find a significant effect of the *Ritu* program on the school absence rates of post-menarche girls, but do not find this effect on girls who have not had their menarche yet. Taking together, this provides further suggestive evidence that there is a link between the positive treatment effects (lower school absence rates) and menstruation.

In order to directly examine if girls are coming to school more often during their menses, we turn to the self-reported survey data. Girls were asked the following survey question: "How often do you miss school due to being on your period?". The answer options ranged from 1 (never) to 4 (always). In line with the findings on general absence rates, we report a significant treatment effect in both treatment arms (Table 9). Treated girls reportedly miss school less often when they have their period than girls in the control group. Again, we find no significant difference between the two treatment groups. In sum, we have used several methods and data sources to examine the treatment effect and they all show similar findings: the menstrual health program significantly reduced girl school absence in both treatment arms, for post-menarche girls. Girls who have had their menarche, came to school more often and our evidence supports the idea of a causal link between the positive treatment effects (lower school absence rates) and menstruation.

TABLE 9
School absence during menstrual period

	FREQ. ABSENCE DURING MP	**FREQ. ABSENCE DURING MP**
	(1)	(2)
T1: School program	-0.297***	-0.311***
	(0.093)	(0.089)
T2: School + HH	-0.343***	-0.329***
program	(0.093)	(0.087)
Control Mean	1.71	1.71
p-value T1=T2^	0.535	0.808
Observations	1,771	1,743
Controls^^	NO	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variable: frequency of missing school due to being on MP, range 1 (never) to 4 (always). ^ 'p-value T1=T2' tests for equality of coefficients, with the null hypothesis $\beta_{t1} - \beta_{t2} = 0$. ^^ Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

4.2.4 *Results: school absence boys*

The *Ritu* program is a multifaceted program, aimed at reducing barriers for adolescent girls to manage their MH and be included in society. A main component of the program is its holistic nature, targeting the entire support system of menstruating girls (including boys in their class). Boys are included in the intervention because boys play a vital role in creating a supportive environment for girls in school, but also for their sisters, their future-wives or future-daughters. The *Ritu* program did not directly aim to improve boy outcomes, but boys were reached by the program and are therefore part of our evaluation. Several aspects of the school program also affect boys; better toilet facilities for boys were built at school, they participated in all MH classes where other topics such as boy puberty were also covered, and the creation of a more open and supportive school environment. Moreover, they played an important role in the pupil school committees which were created, consisting of 50% boys and 50% girls. These factors could affect school attendance for boys.

We used the school record data to measure monthly boy absence rate per grade for all 148 schools. These boys are the classmates of the girls in our sample. Table A - 4 shows the results. Based on the school records, boys in the control group are absent 50.6% of the time. The school program significantly reduced boy absence rates with 10.1 ppts and the combined program reduced it with 12.7 ppts, based on the school records. Boys were not part of our survey sample and therefore we do not have detailed information at the individual level. We held post-program focus group discussions[16] with boys and they reported to be more motivated to attend school because the distance between teachers and pupils decreased, and boys felt more comfortable to ask teachers for support. Moreover, boys had a better understanding of their own puberty and understood better what adolescent girls were experiencing. We do not have further data on the individual level to examine the exact channels through which the Ritu program affected boys and their schooling decision. Our qualitative evidence

[16] *Post-program, we interviewed implementing staff, teachers and boys to find out more about observed changes in school environment and involvement of boys. These interviews were not conducted by an independent agency, but rather by program staff from Dhaka headquarters of the implementing NGO.*

suggests that boys' motivation to come to school increased due to a more supportive school environment, which increased their school attendance.

4.2.5 Secondary educational outcomes: dropouts

The results on school absence showed that the menstrual health program had a significantly positive effect on increasing school attendance of girls. We now examine if this positive schooling effect also had an effect on reducing school dropout rates.

The girls in our sample are on average 13-14 years old and in grade 8 of lower secondary education at the time of the endline survey. Most girls in Bangladesh tend to drop out during higher education (in grade 9 and 10), but the drop out problem also exists in lower grades. In our sample 689 girls dropped out of schools, and we divide them into two categories (based on the data we have collected on them). First, the attrition sample; 354 girls dropped out of school and also could not be found for the endline survey. For these girls, our survey firm CBSG cooperated with school principals, family members and neighbors, to find the reason[17] for dropping out. They found that 57% of these girls dropped out of school because they moved to the capital (Dhaka) to work in the clothing industry. The second most cited reason was marriage (20%). Our second category comprises 335 girls who have dropped out of school, but still live in the study area, and participated in the endline survey. Of this group, 94% reports that dropping out was not their own decision but their parents'. The most cited reasons for drop out are needing to work (72%) or marriage (19%) – these findings are thus in line with our findings on girls in the attrition category.

Even though the *Ritu* program does not directly target the two most cited reasons for dropping out ('needing to work' and 'marriage'), it is likely that menstruation (and especially menarche) affects dropping out. For example, since girls in Bangladesh are typically withheld from the marriage market until menarche occurs (Field and Ambrus, 2008). The *Ritu* program might thus have indirect effects on drop out decisions of parents. However, our sample of girls is relatively young, and has not yet

[17] *And, to verify if the girl had indeed dropped out of school or simply migrated to another school*

reached the stage where most dropping out occurs (grade 9 and 10). Therefore, we expected modest treatment effect on dropout rates. Table 10 shows the results.

TABLE 10
Treatment effect on likelihood of dropout

	(1) Dropout	(2) Dropout
T1: School program	-0.053**	-0.054**
	(0.025)	(0.023)
T2: School + HH program	-0.060**	-0.048**
	(0.023)	(0.021)
Control mean	0.155	0.155
p-value T1=T2^	0.781	0.791
Observations	2,678	2,637
Controls^^	NO	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variable: girl has dropped out of school, 1 (yes) 2 (no), ^'p-value T1=T2' tests for equality of coefficients, with the null hypothesis $\beta_{t1} - \beta_{t2} = 0$. ^^ Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

In the control group, 15.5% of girls had dropped out and girls in both treatment arms were 5.4 ppt (T1) and 4.8 ppt (T2) less likely to have dropped out of school. The menstrual health program thus had a significant effect on reducing girl dropout rates. In line with the findings on school absence rates, we again find no significant difference between the school program and the combined program. Discontinuing education at such a young age, negatively impacts the rest of a girl's life. Moreover, 19% of the dropped-out girls is already married, and an additional 19% expects to be married within the next year (compared to 3% of the school going girls). Next to the negative long-term impact of low education and early marriage - we also see medium-term impact on happiness levels. Dropped out girls were 29% significantly less likely to indicate they were 'very happy' with their lives, compared to all the school going girls in our sample. Reducing school dropout is thus vital, and the significant treatment effect of 5% is a remarkable positive effect of the program.

4.3 Psychosocial Wellbeing

Next to increasing school attendance of adolescent girls, the menstrual health program also aimed to improve their psychosocial wellbeing. The program provided girls with the knowledge, tools, and support needed to confidently manage their periods and be less marginalized during menses. This is expected to influence levels of psychosocial

wellbeing during menses and might extend to improved general levels of psychosocial wellbeing as well. We measured general psychosocial wellbeing outcomes as well as psychosocial wellbeing outcomes during a girl's period. We estimate the impact of the intervention by making use of two indices: the mental health index and the subjective wellbeing index. Recent evidence on menstrual health outcomes has stressed the importance of examining effects in different environments; feeling confident to manage MH in one environment (e.g. at home) does not naturally translate to feeling confident in another environment (e.g. at school or work) (Hennegan et al., 2019; Hennegan and Sol, 2019). Therefore, we also examine confidence levels and prevalence of worries at school and at home. Table 11 shows the descriptive statistics of all psychosocial outcomes.

TABLE 11
Descriptive statistics: Psychosocial outcomes

CATEGORY	VARIABLES	TREATMENT I (N=595)	TREATMENT II (N=570)	CONTROL (N=962)
General	Mental health Index (0-30)	24.1	24.5	24.1
	Subj. Wellbeing Index (0-7)	5.8	5.9	5.9
During MP	Embarrassment (1-4)	3.4	3.5	3.3
	Insecurity (1-4)	3.4	3.6	3.4
At Home	MHM confidence (1-5)	4.4	4.5	4.3
	Worries changing material (1-10)	9.4	9.3	9.3
	Worries MP odor (1-4)	3.6	3.6	3.6
At School	MHM confidence (1-5)	3.8	3.9	3.4
	Worries changing material (1-10)	9.4	9.2	8.6
	Worries MP odor (1-4)	3.6	3.6	3.5

The mental health index is an aggregate measure of two items; frequency of positive and negative feelings[18]. The results are shown in column 1 and 2 of Table 12. On a scale from 0 to 30, girls in the control group have an average mental health score of 24.1, and we find no significant treatment effects. The subjective wellbeing index ranges from 0 to 7 and consists of three items; i) frequency of feelings of shame and humiliation, ii) the extent to which a girl feels treated with respect and iii) treated unfairly. Girls in the control group report an average score of 5.9, indicating a relatively high level of subjective wellbeing. Similar to the findings on the mental

[18] *The Mental Health index comprises 2 questions on positive feelings, and 8 on negative feelings*

health index, we find no evidence that the program increased general levels of subjective wellbeing. Measuring psychosocial wellbeing is a challenge, especially when surveying adolescents. One possible explanation for the lack of significant treatment effect on these general psychosocial wellbeing outcomes, is the relatively high levels of self-reported psychosocial wellbeing in general. This high level could stem from a myriad of factors: experimental demand effects, unwillingness to share unpopular opinions, or living in a culture where people tend to keep their complaints to themselves. Another explanation could stem from the fact that psychosocial wellbeing is influenced by many other factors, unrelated to the treatment factor, and these other factors might overshadow our relatively small treatment effect, rendering it non-significant (column 1 and 2).

TABLE 12
Psychosocial wellbeing: general, and during menstrual period

	GENERAL		**DURING MENSTRUAL PERIOD**	
	Mental Health Index (1)	Subj. Wellbeing Index (2)	Embarrass. during MP (3)	Insecure during MP (4)
T1: School program	0.041	-0.072	0.131**	0.001
	(0.269)	(0.055)	(0.065)	(0.079)
Hochberg corrected p-value	-	-	*0.091**	*0.990*
T2: School + HH program	0.323	0.040	0.220***	0.167***
	(0.255)	(0.050)	(0.059)	(0.059)
Hochberg corrected p-value	-	-	*<0.001****	*0.005****
Control Mean	24.1	5.9	3.3	3.4
p-value T1=T2^	0.331	0.046	0.181	0.040
Observations	2,095	2,095	2,095	2,095
Controls^^	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. Hochberg corrected p-value adjusts for multiple hypothesis testing. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: (1) Mental health index (0-30) the higher the more positive, (2) Subjective Wellbeing Index (0-7), (3) and (4) frequency of feeling embarrassed or insecure during MP (1=always - 4=rarely/never). ^ 'p-value T1=T2' tests for equality of coefficients, with the null hypothesis $\beta_{t1} - \beta_{t2} = 0$. ^^Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

Regarding psychosocial wellbeing during menses, the program directly targeted this outcome and aimed to make girls feel more equipped and confident to manage MH. Therefore, we also measured psychosocial outcomes during menses. Specifically, we examined how often girls feel embarrassed or insecure during their menses. We find strong evidence that the interventions successfully increased psychosocial outcomes

during the menstrual period (Table 12, column 3 and 4). On a scale from 1 (always) to 4 (never), girls in the control group reported an average of 3.3 and we find positive treatment effects on embarrassment levels; treated girls report significantly less embarrassment during their period compared to the control group. We find no significant difference between T1 and T2. Column 4 shows the results on how often girls feel more insecure than usual during their period. The combined program had a significant and substantial positive effect on reducing insecurity during menses, while the school program had no significant effect. The difference in treatment effects between the T1 and T2 is significant at the 5% level (see Table 12). This is the first outcome category for which we find a statistically significant difference between the two treatment groups, our results indicate that the additional household component of the combined program had a slight added value in making girls feel less insecure during their periods.

4.3.1 School vs Home environment

Adolescent girls typically manage their MH in two environments: at home or at school. Therefore, we measured the subjective wellbeing during menses at home and at school. Table 13 shows the impact of the program on subjective wellbeing during menses at school (column 1-3) and at home (column 4-6). At school, we find strong evidence that the interventions increased confidence levels to manage MH (column 1). For safe menstrual health management, it is crucial to hygienically and frequently change menstrual materials. We measured the prevalence of worries associated with changing practices and odor, and found that both treatment arms reduced the prevalence of worries in the school environment (column 2 and 3). For example, regarding worries about changing menstrual materials at school, girls in the control group reported a score of 8.6, on a scale from 1 to 10, where 10 means 'no worries at all'. Treated girls reported significantly less worries, and we find no significant difference between T1 and T2. At home, MHM confidence levels in the control group are high (4.3/5), yet we still find a significant and positive treatment effect in T2 (column 4). The combined program, thus resulted in significantly higher MHM confidence levels for girls at home. Regarding the prevalence of worries during MP, we find that girls across all treatment arms do not report many worries at home and

we find no significant treatment effects (column 5 & 6). In sum, we find positive treatment effects of both the school program and the combined program, especially in improving subjective wellbeing during menses in the school environment. Regarding the home environment, girls do not report high levels of MH worries at home and only the combined program significantly increased MHM confidence levels at home.

TABLE 13
Subjective wellbeing during menses: at school vs at home

	AT SCHOOL			AT HOME		
	MHM confidence	Worries changing material	Worries about MP odor	MHM confidence	Worries changing material	Worries about MP odor
	(1)	(2)	(3)	(4)	(5)	(6)
T1: School program	0.401***	0.831***	0.136**	0.101	0.084	0.058
	(0.094)	(0.184)	(0.052)	(0.069)	(0.140)	(0.053)
Hochberg-corr.	*<0.001****	*<0.001****	*0.010***	*0.450*	*0.549*	*0.417*
T2: School + HH program	0.519***	0.538***	0.152***	0.168**	0.049	0.081
	(0.096)	(0.190)	(0.053)	(0.072)	(0.106)	(0.053)
Hochberg-corr. p-value	*<0.001****	*0.005****	*0.007****	*0.069**	*0.664*	*0.192*
Control Mean	3.4	8.6	3.5	4.3	9.3	3.6
p-value T1=T2^	0.239	0.066	0.770	0.393	0.816	0.706
Observations	2,042	936	2,033	2095	2,095	2,095
Controls^^	YES	YES	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. Hochberg corrected p-value adjusts for multiple hypothesis testing. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: Perceived confidence in managing MH (range 1-5) in column (1) and (4), Worries about changing material (range 0-10) in column (2) and (5), Likelihood of worrying about MP odor (range 1-4) in column (3) and (6). ^'p-value T1=T2' tests for equality of coefficients, with the null hypothesis $\beta_{t1} - \beta_{t2} = 0$. ^^Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

4.4 Empowerment

TABLE 14
Descriptive statistics: Empowerment outcomes

CATEGORY	VARIABLES	TREATMENT I	TREATMENT II	CONTROL
General	Empowerment Index (0-1)	0.55	0.59	0.54
	Gender Attitudes Index (0-13)	8.62	9.16	8.55
	Opinion & Decision Index (0-7)	2.58	2.88	2.44
	Aspiration index (0-2)	1.41	1.54	1.42

Our third main outcome category is the empowerment level of adolescent girls. The program provided girls with the knowledge, tools, and support needed to feel more empowered during their menses and to have more freedom of movement. This is expected to influence the empowerment of girls during their menses, and might manifest in increased general empowerment as well. Instead of using adult female empowerment measures[19] (such as age of marriage, intra-household bargaining power), we used measures of empowerment appropriate for adolescent girls. We asked them about situations where they might be able to exert some level of empowerment, such as raising a hand in class. Our empowerment index ranges from 0 to 1 and comprises three sub-indices; gender attitudes, expressing opinions and decisions, and aspirations. The gender attitudes index ranges from 0 to 13 and comprises 13 equality statements, where girls either showed gender equal attitudes, or gender unequal ones. A score of 13 indicates perfectly equal gender attitudes. The aspiration index is composed of educational aspiration level and aspired age of marriage. Table 14 shows the descriptive statistics of the empowerment variables. Similar to the analysis of the psychosocial outcomes, we first explore treatment effects on empowerment in general and then examine effects on empowerment during menses.

Table 15 shows the impact[20] of the menstrual health interventions on our main outcome variable: the empowerment index (column 1). The school program does not show a significant effect on the empowerment index. For the combined program, we find a significant yet small positive treatment effect of 0.047. The school program did not have a significant impact on any of the subindices[21] (columns 2-4), but the combined program significantly increased the gender attitudes index, opinions and decisions index, and the aspiration index. The additional household component of the combined program thus seems to have had a small yet significant positive effect on increasing empowerment levels of girls.

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[19] Originally, we planned to use the traditional measure: mobility. Yet our data showed the majority of girls never frequented the listed places (regardless of menstruation). See Table A - 7 in the appendix for the results.

[20] Similar to all other regressions, we have added control variables to the estimations. In this case, the baseline empowerment variables are significant, suggesting baseline empowerment levels are an important driver of current empowerment level of girls.

[21] Appendix Table A - 8, Table A - 9 and Table A - 10 show the estimates of all individual outcomes per index.

TABLE 15

Empowerment outcomes

	EMPOWERMENT INDEX	GENDER ATTITUDES INDEX	OPINIONS & DECISIONS INDEX	ASPIRATIONS INDEX
	(1)	(2)	(3)	(4)
T1: School program	0.013	0.109	0.106	-0.005
	(0.014)	(0.222)	(0.159)	(0.041)
T2: School + HH program	0.047***	0.513**	0.378**	0.101**
	(0.017)	(0.214)	(0.181)	(0.047)
Control mean	0.54	8.55	2.44	1.42
p-value T1=T2^	0.064	0.113	0.191	0.029
Observations	1,707	2,052	1,734	2,084
Controls^^	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: (1) Empowerment index ranges from 0 to 1, (2) Gender attitudes index (0-13), (3) Opinions and decisions index (0-7), (4) Aspiration index (0-2). ^ 'p-value T1=T2' tests for equality of coefficients, with the null hypothesis $\beta_{t1} - \beta_{t2} = 0$. ^^ Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and empowerment and household progress out of poverty index (PPI), and number of female role models in household.*

4.4.1 Mobility during menses

TABLE 16

Empowerment: mobility during menses

PANEL A	GOING TO SCHOOL	PHYSICAL SPORTS	EATING WHITE FOOD	EATING PROTEIN	PLAYING WITH KIDS	SIT BOY SEAT	SURROUND MEN/BOYS	SERVING FOOD/DRINK
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T1: School program	0.145***	0.151***	0.280***	0.089***	0.097***	0.083**	0.070*	0.051**
	(0.035)	(0.038)	(0.033)	(0.019)	(0.037)	(0.042)	(0.039)	(0.022)
T2: School + HH program	0.154***	0.201***	0.314***	0.097***	0.145***	0.140***	0.145***	0.068***
	(0.032)	(0.038)	(0.031)	(0.019)	(0.038)	(0.036)	(0.038)	(0.022)
Control Mean	0.75	0.51	0.62	0.86	0.64	0.72	0.71	0.89
p-value T1=T2^	0.719	0.221	0.137	0.549	0.213	0.127	0.054	0.305
Observations^^	2,095	2,026	2,093	2,095	1,971	2,086	2,095	1,977
Controls^^^	YES	YES	YES	YES	YES	YES	YES	YES
PANEL B	**WORKING IN FIELD**	**GOING OUTSIDE**	**COOKING**	**BATH IN POND**	**HOMEWORK**	**FETCH WATER**	**RELIGIOUS SPACE**	**RELIGIOUS ACTIVITY**
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
T1: School program	0.041	0.034	0.014	0.056	0.023	0.018	0.008	0.048**
	(0.048)	(0.022)	(0.024)	(0.037)	(0.014)	(0.015)	(0.007)	(0.023)
T2: School + HH program	0.172***	0.040**	0.068***	0.107***	0.034***	0.031**	0.011	0.020
	(0.046)	(0.018)	(0.018)	(0.035)	(0.012)	(0.015)	(0.007)	(0.023)
Control Mean	0.60	0.89	0.88	0.78	0.94	0.94	0.01	0.05
p-value T1=T2^	0.013	0.733	0.013	0.139	0.384	0.364	0.709	0.304
Observations^^	1,296	2,095	1,485	1,514	2,091	2,057	2,081	2,092
Controls^^^	YES	YES	YES	YES	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: avoid certain activity 0 (yes) 1(no). ^'p-value T1=T2' tests for equality of coefficients, with the null hypothesis $\beta_{t1} - \beta_{t2} = 0$. ^^ Girls, in some cases, never performed a listed activity at all, also not when they were not on their period, resulting in missing values. Therefore, the number of observations per activity fluctuates. ^^^ Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

In our research setting, and in many other LMICs, certain daily activities are considered taboo for a menstruating girl to engage in. These activities include for

example; attending school, eating white food, cooking, being around men, or performing religious activities. For example, in this area there is a strong belief that when a girl is menstruating, she can get pregnant if she sits in a seat a boy previously sat in. In this case, proper education on the female reproductive system could result in changes in behavior. Other activities however, such as praying whilst on menses, have their roots in religion and increasing MH knowledge and support is less likely to influence if menstruating girls are allowed to pray. We examined the impact of the program on girls' mobility during menses, where we asked girls if they avoided certain activities during their menstruation. The results indeed show differences in treatment effects per activity.

We find that the *Ritu* program significantly reduced avoidance of almost all activities except the religious ones, which are still strongly upheld for more than 95-99% of all girls. The results are shown in Table 16 where Panel A shows results for activities where the program had a significantly positive and substantial effect in both treatment groups. For example, regarding 'white food' (column 3), in the control group only 62% of girls do not avoid white food, while the school program substantially increased this to 90% of girls (+28 ppts) and the combined program to 93% (+31 ppts). Column 7 shows that 71% in the control group do not avoid being around men or boys when menstruating. 'Being around males' is a broad concept, but it is important since it also includes attending (mixed-gender) schools. The school program slightly increased this percentage to 78% (+7ppts) while the combined program increased it to 86% (+15 ppts). In Panel B, columns (9) - (12) show the results for activities where the combined program had a significant treatment effect but the school program had non-significant effects. For example, in the combined program girls are less likely to avoid the following activities; going outside, working in the field, cooking, and bathing in a pond. Columns (14) to (16) show the results of activities where the *Ritu* program did not have a significant and substantial impact, either because almost no one avoided the activity in the first place (column 13 and 14) or because the avoidance of the activity is still strongly upheld (entering a religious space, and performing religious activities in column 15 and 16). Overall, the *Ritu* program had a significant and positive effect on the mobility of girls during their menstruation – although some

activities remain more avoided than others. Additionally, for some activities the combined program was more effective at increasing mobility than the school program.

4.5 Secondary outcomes – Menstrual Health outcomes

TABLE 17
Descriptive statistics: Menstrual Health outcomes

VARIABLE	DETAILS	TREATMENT I	TREATMENT II	CONTROL
Panel A. Menstrual Health practices				
Predominant material used at home	% Sanitary pad	35%	34%	25%
Predominant material used at school	% Sanitary pad	54%	53%	36%
Changing material freq. (range 1-5)	Mean	3.1	3.0	2.7
Ever change material at school	% yes	49%	50%	13%
Drying place (range 0-3)	Mean	2.6	2.7	2
Freq. wearing dry material (range 1-3)	Mean	1.5	1.4	1.9
Panel B. Menstrual Health communication				
Comfortable discussing MH	% yes	67%	72%	52%
Discussed MH in last 3 months with:				
Parents	% yes	58%	66%	48%
Friends	% yes	59%	63%	44%
Teacher	% yes	39%	38%	6%

4.5.1 Menstrual Health – Practices

Menstrual health practices vary in terms of comfort and hygiene and we report on three key dimensions of this category: the type of menstrual material used, the frequency of changing material and the drying of material. Table 17 shows the descriptive statistics. We examined the predominant menstrual material used by girls and found that they either used sanitary pads or cloth. Girls predominantly use cloth when they are at home, and are more likely to use sanitary pads when they are at school. Even though there is no universal 'best practice', sanitary pads are in general considered the superior material since they are more comfortable and preferred from a hygiene perspective. The availability of sanitary pads is not a problem in our area of study, with local markets at walking distance, selling sanitary products for reasonable prices.

25% of girls report to predominantly use disposable sanitary pads at home (Table 17). Table 18 (column 1) shows the regression estimates and we find a significant treatment

effect in both treatment groups of +10.2 ppts (school program) and +7.4 ppts (combined program). Girls in both treatment groups are thus significantly more likely to use sanitary pads at home than girls in the control group – although cloth remains the predominant material for the majority of girls. These results are robust to the Hochberg correction of multiple tests, and they are also robust to individual characteristics such as wealth levels. The treatment effect is even larger at school (column 2). 36% of girls in the control group use sanitary pads as their predominant material in school and *Ritu* increased this percentage with +18.5 ppts in the school program and +15.2 ppts in the combined program. Next, we asked how frequently girls changed their material on the heaviest day of their period. Girls in the control group changed material on average 2.7 times (Table 17). Treated girls changed their menstrual material significantly more frequently (column 3), and were also more likely to change menstrual material at school (column 4). Only 13% in the control group ever changed their material at school, whilst in the treatment groups approximately 50% of all girls indicated they change their material at school (Table 17). We find no significant differences in treatment effects between T1 and T2.

Another indicator of hygiene is the place where girls leave their menstrual materials to dry after washing. This measure ranged from least hygienic (0= inside and covered) to most hygienic (3= outside in the sun). Girls in the treatment groups were significantly more likely to use a more hygienic drying spot than girls in the control group (column 5). In the control group only 48% hung washed material outside in the sun, compared to 77% (T1) and 84% (T2). We also find that the treatment effect of the combined program was significantly higher than of the school program. Regarding the frequency of wearing completely dry[22] menstrual materials, on a scale from 1 (never) to 3 (always) 67% of girls in the school program and 72% of girls in the combined program reported that their materials were never completely dry. In the control group, this number is significantly less: 47%. The program thus increased the likelihood of girls reporting to use wet material, which could be due to two reasons.

[22] *No longer wet after washing the material*

First, treated girls were more aware of their practices and more likely to have registered that they indeed used wet material. Second, since treated girls changed their materials more often, they will have to wash it more often which leaves less time for drying if there is not sufficient other material. This could thus be an unintended negative side effect of the *Ritu* program, although we did not find any differences in physical health of girls (e.g. no differences in incidence of skin rashes or irritations between treatment and control groups).

TABLE 18
Menstrual Health – Practices

	PREDOMINANT USE SANITARY PADS		CHANGING MATERIAL		DRYING MATERIAL	
	Home	School	Freq. general	At School	Drying place	Freq. wear dry
	(1)	(2)	(3)	(4)	(5)	(6)
T1: School program	0.102**	0.185***	0.359***	0.356***	0.536**	-0.360***
	(0.040)	(0.044)	(0.055)	(0.038)	(0.071)	(0.075)
Hochberg p-value	0.012**	<0.001***	<0.001***	<0.001***	<0.001***	<0.001***
T2: School + HH program	0.074*	0.152***	0.250***	0.370***	0.675***	-0.492***
	(0.043)	(0.046)	(0.065)	(0.039)	(0.064)	(0.069)
Hochberg p-value	0.086*	0.001***	<0.001***	<0.001***	<0.001***	<0.001***
Control mean	0.25	0.36	2.7	0.13	2.0	1.88
p-value T1=T2^	0.551	0.506	0.103	0.769	0.051	0.092
Observations	2,061	2,032	2,095	2,042	1,470	1,470
Controls^^	YES	YES	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. Hochberg corrected p-value adjusts for multiple hypothesis testing. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: Predominant menstrual material used is sanitary pads, (1) Yes 0(No) – column (1) and (2), frequency of changing material on the heaviest day of MP (range from 1 (once) to 5 (5 or more times) in column (3), 'do you ever change menstrual material at school (1) yes (0) no, in column (4). The drying place for washed menstrual material ranged from least hygienic (0= inside and covered) to most hygienic (3= outside in the sun) - in column (5), frequency of wearing completely dry menstrual material (1 (never) to 3 (always)) in column (6). ^ 'p-value T1=T2' tests for equality of coefficients, with the null hypothesis $\beta_{t1} - \beta_{t2} = 0$. ^^Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

4.5.2 Menstrual Health – open communication

By its very definition, taboo topics are generally not openly discussed. One of the main objectives of the *Ritu* program was to break the silence, and create an environment where girls had a more open attitude, and a supportive environment which could make them more likely to talk about topics related to MH. Table 17 shows that in the control group 52% of girls were comfortable talking about MH in general, and within the last three months they have mostly done so with either a parent or a friend. Table 19 shows the treatment effects. Girls in both treatment groups reported to be significantly more comfortable talking about MH in general, and were more likely to

have discussed topics related to MH with their parents, friends or teachers. The effect sizes are large and significant. Especially the effect size on teachers is large (column 4), with only 6% of girls in control group ever discussing MH with their teachers compared to 39% (T1) and 38% (T2).

TABLE 19
Menstrual health – Open communication

		IN LAST 3 MONTHS, DISCUSSED MH WITH:		
	COMFORTABLE TALKING ABOUT MH	PARENT	FRIENDS	TEACHER
	(1)	(2)	(3)	(4)
T1: School program	0.153***	0.105**	0.161***	0.335***
	(0.035)	(0.044)	(0.044)	(0.051)
Hochberg p-value	*<0.001****	*0.018***	*<0.001****	*<0.001****
T2: School + HH program	0.175***	0.164***	0.182***	0.314***
	(0.036)	(0.044)	(0.040)	(0.051)
Hochberg p-value	*<0.001****	*<0.001****	*<0.001****	*<0.001****
Control mean	0.52	0.48	0.44	0.06
p-value T1=T2^^	0.516	0.204	0.680	0.770
Observations	2,095	2,095	2,095	2,093
Controls^^	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. Hochberg corrected p-value adjusts for multiple hypothesis testing. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: binary variables (0=No, 1=Yes). ^'p-value T1=T2' tests for equality of coefficients, with the null hypothesis* $\beta_{t1} - \beta_{t2} = 0$. *^^Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

5 Heterogeneity

The *Ritu* program aimed to be as inclusive as possible, empowering all girls to overcome menstrual barriers by providing different options and tackling the entire support system. At the same time, the program might have had different effects for certain sub groups and this could be informative for future MH programs. We therefore perform a heterogeneity analysis to test if the program succeeded in being inclusive for all, or if treatment effects were stronger for certain subgroups than others. Following our pre-analysis plan, we assessed the degree of heterogeneous treatment effects for; pre-program menarche, grandparents in household, household poverty index, female role models, psychosocial wellbeing and pre-program levels of empowerment. We used the following regression model:

$$Y_{ij} = \beta_0 + \beta_1(\mathrm{T1} * \mathrm{H})_{\mathrm{ij}} + \beta_2(\mathrm{T2} * \mathrm{H})_{\mathrm{ij}} + \beta_3 \mathrm{H_i} + \beta_4 \mathrm{T1_j} + \beta_5 \mathrm{T2_j} + \beta_4 \mathrm{X_{ij}} + \varepsilon_{\mathrm{ij}} \quad (5)$$

Where Y_{ij} is the outcome of girl i in school j; for this heterogeneity analysis we will not report on all outcome variables, rather we focus on our three primary outcomes: education, psychosocial wellbeing, and empowerment. Following our main regression model, the standard errors are clustered at the school level and we added controls for all three strata (X_{ij}). $\mathrm{H_i}$ is the respective heterogeneous variable, $\mathrm{T1_j}$ and $\mathrm{T2_j}$ are treatment dummies.

We find no strong evidence for differential treatment effects across the subgroups (Appendix h). This evidence supports the hypothesis that the *Ritu* program was inclusive, and factors such as presence of female role models in the household or poverty did not hold girls back from being positively impacted by the program.

We only find modest heterogeneous treatment effects for pre-program levels of empowerment (measured by gender equity measures and aspirations). Table A - 11 in the appendix shows the heterogenous treatment effects of gender equity. We find no heterogeneous treatment effects of gender equity in the combined program. For the school program, we find no heterogeneous treatment effects on general outcomes (education in general, psychosocial outcomes in general) but we do find that girls with higher gender equity levels saw higher treatment effects on school attendance during menses, and psychosocial wellbeing during menses. Regarding pre-program aspiration levels, we find mixed results (Table A - 12). We find no heterogenous treatment effects of aspiration levels on school attendance. However, we do find that girls with higher pre-program aspiration levels experienced stronger treatment effects on psychosocial wellbeing. In sum, we find modest heterogeneous treatment effects for pre-program levels of empowerment. The findings suggest that the program was additionally beneficial for girls with higher empowerment levels at baseline compared to girls with lower empowerment levels at baseline.

6 Cost-effectiveness

Cost-effectiveness (CE) analyses of menstrual health programs are rare in the literature, as well as CE of educational programs addressing gender specific barriers through engagement of teachers and parents. Our results so far have shown a significantly positive impact of both the school program and the combined program. However, in order to make informed policy decisions, the implementing costs of the program should be considered. This is particularly informative, since T1 (the school program) was substantially cheaper than T2 (the combined program). The household component of treatment 2 is costly; tracking all parents in their rural homes and delivering the program in their communities is considerably more costly than delivering the program at school level. Next to assessing the overall cost-effectiveness of the program, it is therefore valuable to also compare the CE across the two different treatment groups.

The *Ritu* program realized significant treatment effects on many outcome variables, yet for the cost-effectiveness analysis we will focus on its effect on education; reducing school absence rates of girls. Years of schooling and school attendance are standard outcome measures in CEAs (Buchmann et al., 2018), and it was one of the main aims of the program. Much of the CE literature in development focuses on education since the outcomes are easily quantifiable, can be compared across nations and because female education is an importance indicator of (future) development and wellbeing. The CE literature on MH programs is limited, therefore we will also compare our findings to other educational programs. We first describe which assumptions and methods we used to estimate the cost-effectiveness of the program and will then present the results.

6.1 Cost-effectiveness method

Throughout the program implementation, we have collected detailed information on the implementation costs. This allows us to examine unit costs, and assess the overall costs per treatment arm. We compare these costs to our impact measure: the increase in school attendance, expressed in (learning-adjusted) years of schooling. In the educational results section, we found that the school program increased female school

attendance with 10.3 ppts and the combined program with 6.8 ppts (Table 8 column 2)[23]. In other words, the medium-term impact of the program is an increase of 0.103 years of schooling in T1 and 0.068 years per treated girl in T2. We multiply this individual treatment effect by the total number of beneficiaries in the program, correcting for the number of girls that did not receive full treatment[24]. We calculate the cost-effectiveness ratio using the following formula:

$$Cost\ Effectiveness\ Ratio = \frac{Total\ cost\ of\ program\ per\ treatment\ arm}{Total\ additional\ years\ of\ schooling\ per\ treatment\ arm} \quad (6)$$

Expressing the impact of an educational program in 'years of schooling', is the traditional measure used in CE analyses. This is informative when comparing educational program within nations but it falls short when comparing between nations because the quality of educational systems varies profoundly. Therefore, next to reporting on additional years of schooling, we will also use a relatively new benchmark from the World Bank, which adjusts for differences in quality of schooling across nations; the Learning-Adjusted Years of Schooling (LAYS). The intuition behind LAYS is comparable to the intuition behind the Quality-Adjusted Life Years (QALYs) and the Disability-Adjusted Life Years (DALYs) measures; where years of life are adjusted for the quality of life. The LAYS were introduced in 2018 by the World Bank, to correct traditional measures of human capital (e.g. years of schooling) for the various levels of school quality across countries (Filmer et al., 2020; World Bank Group, 2018). We calculate the additional LAYS following Filmer et al. (2019);

$$Additional\ LAYS_{T_i} = Additional\ Years\ of\ Schooling_{T_i} * R^{n}_{BGD} \quad (7)$$

The additional LAYS per treatment arm is the product of additional years of schooling and a measure of the quality of learning in Bangladesh (R^{n}_{BGD}) compared to other

[23] *In the educational analyses, we presented three data sources on school attendance. Following the CE literature, we only use the estimates on the school records data, since this was the only method based on daily attendance and suitable for the CE analysis.*

[24] *Girls who did not have their period yet, and therefore hardly benefited from the program*

countries. Where T_i is treatment 1 or treatment 2. The quality measure is based on the TIMS[25] (Trends in International Mathematics and Science) score of Bangladesh, compared to the benchmark of 625 (the highest possible TIMS score). We used World Bank data to collect the Bangladeshi TIMS 2017 scores, subsequently we calculated relative quality of learning in Bangladesh as follows;

$$R^{n}_{BGD} = \frac{Average\ Learning\ per\ Year_{BGD}}{Highest\ possibel\ average\ Learning\ per\ Year} = \frac{368}{625} = 0.589 \quad (8)$$

We calculate the cost-effectiveness ratio for learning-adjusted years of schooling using the following formula:

$$Cost\ Effectiveness\ Ratio = \frac{Total\ cost\ of\ program\ per\ treatment\ arm}{Total\ additional\ LAYS\ per\ treatment\ arm} \quad (9)$$

Regarding the costs, we follow the guidelines of Dhaliwal et al. (2013) and use the standard conversion factors[26]. All program costs were incurred in the base year (the implementation year) and we use the first date of the fiscal year for our analyses. We express costs in 2017 USD using standard EURO-USD exchange rates and not Purchasing Power Parity, following Dhaliwal et al. (2013). Table 20 shows the overview of program costs per treatment arm, and total number of beneficiaries. The total costs for implementers of treatment arm 1 was $419,921, and $714,527 for treatment arm 2.

TABLE 20
Overview of program costs (in 2017 US dollars) and beneficiaries

	TREATMENT 1 SCHOOL PROGRAM	**TREATMENT 2** COMBINED PROGRAM
Total cost to implementer	$419,921	$714,527
Total number of schools	41	37
Total number of beneficiaries ^	7,000 girls	7,000 girls

[25] *The TIMS is a worldwide effort to assess the skills of pupils 9-10 and 13-14 around the world*

[26] *Exact calculations, and cost breakdown available upon request*

^girls in grade 6-8 during program implementation

6.2 Cost-effectiveness results

Table 21 shows the cost-effectiveness results. Column 1 repeats the impact estimates on educational outcomes, we also report the upper and lower bound using a 90% confidence interval. Column 2 shows the costs per additional year of schooling for girls, and we find that the school program was more cost-effective than the combined program. For the school program, it costs $661 to realize an additional year of schooling compared to $1787 in the combined program. We also calculate the CE in terms of LAYS, and find that in the school program one additional learning-adjusted school year costs approximately $1123, compared to $3035 in the combined program (column 3). It would thus cost approximately three times more to realize an additional year of schooling with the combined program, than it would using the school program. This is in part due to a slightly lower impact estimate (0.068 additional years of schooling, compared to 0.103 in the school program), but mostly due to the high costs associated with the household component of the combined program compared to the relatively cheaper school-based intervention.

In order to compare our findings to other CE literature, we calculate how many additional years of schooling can be realized per $1000 spent. Using this measure, the school program results in 1.51 extra years of schooling per $1000 spent, and the combined program leads to 0.56 extra years of schooling. We compare these CE estimated to the most cost-effective school programs internationally, as well as to other school programs in Bangladesh.

TABLE 21
Cost-effectiveness results per treatment arm

		EDUCATIONAL IMPACT ESTIMATE	COSTS PER ADDITIONAL YEAR OF SCHOOLING	COSTS PER ADDITIONAL LEARNING-ADJUSTED YEAR OF SCHOOLING
		(1)	(2)	(3)
Treatment arm 1	Point estimate	0.103	$661	$1123
School program	Upper bound^	0.142	$478	$812
	Lower bound	0.064	$1072	$1821
Treatment arm 2	Point estimate	0.068	$1787	$3035
Combined program	Upper bound	0.116	$1050	$1739
	Lower bound	0.020	$5988	$10170

^90% Confidence interval

One of the most cost-effective programs to increase educational attainment in LMICs is deworming school children[27]. In Kenya every $100 spent by a deworming program led to 11.91 additional years of education or 8.7 learning-adjusted years of schooling (Miguel and Kremer, 2004). The cost-effectiveness literature on menstrual health programs is limited, but one randomized evaluation by Oster and Thornton (2011) assessed the impact of providing menstrual products to girls in Nepal, and found no effect on school attendance; reducing its cost-effectiveness to zero. In Bangladesh, three studies with school girls as beneficiaries have reported cost-effectiveness of programs aimed at increasing educational attainment. Two programs were implemented nation-wide in Bangladesh and specifically aimed to increase female school attendance (the Female Secondary School Assistance Program and the Free Tuition Policy), two studies report on its cost-effectiveness (Hahn et al., 2018; Hong, S. Y., & Sarr, 2012). Two other programs, evaluated by Buchmann et al. (2018), were implemented in a rural district in Bangladesh and aimed to reduce child marriage and teenage childbearing, and increase female school attainment, through an empowerment program and through a conditional incentive program. The results range from 0.15 to 4.30 additional years of schooling for every $1000 spent (Buchmann et al., 2018; Hahn et al., 2018; Hong, S. Y., & Sarr, 2012), or 0.09 to 2.45 additional

[27] *By comparison, using conditional cash transfers in Mexico led to 0.01 additional years of education for every $100 spent (Schultz, 2004). In general, using cash transfers, scholarships, reducing costs of schooling or other incentives are not the most cost-effective approaches (Baird et al., 2011; Banerjee et al., 2007; Behrman et al., 2009; Bobonis et al., 2015; Burde and Linden, 2013; Duflo et al., 2017, 2012; Jensen, 2010; Kremer et al., 2009; Schultz, 2004). Programs aimed at reducing school travel time, or improving health of children have proven to be more cost-effective* (Barrera-Osorio et al., 2011; Burde and Linden, 2013; Miguel and Kremer, 2004).

learning-adjusted years of schooling[28] for every $1000 spent (see Table A - 18 for the estimates per study). The *Ritu* school program resulted in an estimate of 1.51 years of schooling per $1000 spent (or 0.89 LAYS) and for the combined program, an additional 0.56 years of schooling per $1000 spent (0.38 LAYS), our CE estimates thus fall in the range of existing evidence in Bangladesh.

In terms of long-term cost-effectiveness of the *Ritu* program, it shows great potential for several reasons. First, even though estimating the returns to schooling is subject to many challenges and underlying assumptions, the consensus is that one additional year of education in low-income countries is on average correlated with an increase in long-term income of 8 to 10 percent (Montenegro and Patrinos, 2013). Second, our calculations only included girls who were still enrolled in school, and did not account for the significant reduction in dropout rates of girls due to data limitations[29]. This likely results in an underestimation of the CE estimate. Third, we took a conservative approach in counting the number of beneficiaries of the program. We only counted the number of girls in school during program implementation. However, a key component of the program is its sustainability and focus on capacity building (for example integrating MH modules in the school curriculum, empowering teachers to continue teaching the modules on their own, and laying the foundation for a sustainable source of funding for the maintenance of MH-friendly toilet facilities in schools). Incoming cohorts of pupils will therefore likely benefit from the program as well, and this increases the total number of beneficiaries and improves the CE estimates. Fourth, the *Ritu* program did not solely have an effect on female education, but also on other important outcomes (psychosocial wellbeing, empowerment, menstrual health outcomes and male education). Our cost-effectiveness estimates are thus very conservative, and should be interpreted as lower bound estimates of the true cost-effectiveness of the *Ritu* program.

[28] *we converted these estimates into additional learning-adjusted years of schooling, using the same method as before (see formula 7*

[29] *We did not have the exact data on the date and year of dropping out and therefore we could not calculate exactly how many days of schooling she had missed compared to girls who stayed in school.*

7 Discussion

This study examines whether a multi-faceted menstrual health program leads to improvements in MH outcomes, education and a range of psychosocial outcomes of adolescents in Bangladesh. We investigate two versions of an MH program; 1) a school-based intervention focused on improving toilet facilities in school and providing MH education for headmasters, teachers, girls and boys and 2) an additional household level intervention complementary to the school-based intervention, focused on providing MH education for parents. Promoting the inclusion and acceptance of a marginalized group, such as menstruating girls, requires both a comprehensive intervention as well as a comprehensive method of measuring the impact. The *Ritu* program targeted all facets of menstrual health barriers; from knowledge and tools, to supportive environments (including head masters, teachers, boys, parents and prevailing restrictive beliefs). Our study showed the importance of using comprehensive measures for every program aspect, especially since the evidence base on MH programs is small. For example, we found that support systems at school have improved, not just due to improved toilet facilities but also because other (male) pupils and teachers better understand MH challenges and show support. Teachers felt more supported by their head masters and school committees, which provided them with the freedom and confidence to teach the MH modules in class. We also find that certain MH outcomes are dependent on the environment in which a girl managed her menstruation. For example, confidence to manage MH in the home environment, does not necessarily equate confidence to manage MH in a school environment. Our findings stress the importance of using a comprehensive set of measures and accounting for different environments, when studying the effects of MH programs.

An important feature of the *Ritu* program is its focus on the hygienic use of menstrual materials but leaving it up to the beneficiary to use the preferred material of her own choice. This ensured the inclusivity of the program; every adolescent girl could adopt her own hygienic practice, regardless of household wealth, availability of pads in the market or beliefs of her parents. We believe this to have been crucial to the success of

the program since cloth remains the most commonly used menstrual material (and not sanitary pads), both in our research setting and in similar settings in Bangladesh (Alam et al., 2017). We find significant and positive effects on menstrual health outcomes (such as MH practices, beliefs and communication), which is important since quantitative evidence on the causal impact of MH programs on menstrual health outcomes is scarce, especially for programs that did not focus on providing sanitary pads. Our findings show the importance of tailoring an MH program to the target population and providing beneficiaries with several options for menstrual practices.

Improving MH outcomes is important, but our prime interest is to investigate the effects on development outcomes, such as psychosocial wellbeing and empowerment of adolescent girls. We find no significant treatment effect of the school program but the combined program significantly increased general empowerment levels (although the effect size is economically insignificant). These results could either stem from the program not succeeding in raising general levels or from measurement issues. Adult female empowerment and psychosocial outcomes are difficult to estimate and quantify, and this is no different for adolescent female empowerment (Almås et al., 2018; Bonilla et al., 2017; De Walque and Valente, 2018). For example, given the high mean and low standard deviation of general psychosocial wellbeing outcomes in the control group, we lack power to detect realistic improvements in the treatment groups. However, psychosocial wellbeing and empowerment levels during menses can be measured more directly, and here we find a positive treatment effect of both the school program and the combined program. For example, one of the main aims of *Ritu* is promoting the inclusion of menstruating girls in society, and we find that mobility of girls during their menses increased significantly; they were more likely to perform mundane activities that were traditionally considered taboo for menstruating girls. These findings are important for policymakers, because the results suggest that long prevailing restrictive beliefs surrounding menstruation, are at least partially malleable and the mobility of menstruating girls can be improved.

A key question is whether the MH program led to increased school attendance of menstruating girls because school attendance is not only a critical indicator for

development of adolescent girls, it is also a good way of measuring if menstruating girls have all the knowledge, tools and support they need to be accepted in society and partake in daily activities such as coming to school. It is challenging to collect reliable data on school attendance in many low- and middle-income countries, and we rigorously measured school attendance using three different data sources; surveys, spot-checks and school records. We are the first to measure the causal impact of an MH program on such a rigorous school dataset. In the control group, we find that pre-menarche girls have significantly lower school absence rates than girls who have started menstruating; providing further evidence that girls indeed miss school due to being on their periods. In the treatment groups, we find strong evidence that girls' school absence reduced, with all three datasets showing significant and large treatment effects for post-menarche girls, suggesting some sort of catching-up effect. We do not find any school absence effects on girls who have not had their menarche yet, and this supports the idea of a causal link between the positive treatment effects (lower school absence rates) and menstruation. This hypothesis is further strengthened by the fact that treated girls reported to miss school less often during their periods than girls in the control group. Taken together, these results provide suggestive evidence that girls' absence rates were reduced due to girls coming to school more often during their periods, rather than general increases in school attendance by girls. Menstrual barriers are by no means the only barriers to education for girls. In fact, in our study setting, girls reported that bad weather (heavy rain and floods) was the main reason for missing school, followed by being needed at home. Despite this, we find large and significant treatment effects, suggesting that menstrual barriers play a vital role in education and should not be overlooked. Moreover, we find that the program significantly reduced school dropout rates as well. Especially in low-income countries, a higher education level tends to be associated with higher levels of wealth and empowerment throughout the entire life span. Policymakers should thus aim to reduce as many barriers to education as possible, and holistic MH programs could help.

So far, we have focused on the effects on menstruating girls because that is the main aim of the *Ritu* program. However, boys are an important part of the MH support

system of girls and thus were also targeted by the interventions – therefore we also investigate how boys were affected by the program. Certain aspects of the MH program also affected boys, such as better toilet facilities, lessons on boy puberty, and a more open and supportive environment at school. We are the first to rigorously measure causal effects of an MH program on boys, and find significant treatment effects. It is important to note that barriers to schooling for boys are different from barriers for girls, and thus the channels through which the *Ritu* program affected boys were different from how it affected girls. For girls, we found that the reduction in absence rates did not stem from general improvements in attendance, but from menstruating girls coming to school more often. For boys however, we find general improvements in school absence rates, which is likely to stem from higher interest and motivation to come to school due to a more supportive environment. In rural Bangladesh, 'lack of interest in school' was the third most cited reason for missing school among boys, whereas girls mostly cite reasons outside their own control (Subrahmanyam, 2016). Our dropout analysis shows similar findings, girls had mostly dropped out of school due to 'needing to work' (57%) or marriage (20%). Both reasons, are mostly out of a girl's control and not related to her own interest in school. Naturally, boys also face many barriers to education (such as poverty, and low perceived value of education) but they are often left with some degree of agency on their schooling decision, unlike girls (De Walque and Valente, 2018). A more supportive and engaging school environment might thus be a reason why they decided to come to school more often. In fact, our limited qualitative findings suggest that boys indeed felt more supported at school and felt more comfortable talking to teachers in treatment schools. Taken together, these results suggest that boys have some degree of agency in their schooling decision and the more supportive environment at school created by the *Ritu* program has led them to attend school more often. It is possible that girls were also more motivated to come to school in general (and not only during menses), just like boys, but because girls face other barriers to schooling than boys, and tend to have less agency in their schooling decision, it might not have materialized in lower school absence rates. There is currently a gap in the literature on the effect of MH programs on boy school absence rates. Future research

should devote more resources into collecting information on the impact on boys and delve deeper into how the effect of MH programs on menstrual barriers to education interacts with other barriers to education for girls.

Next to investigating the impact of the program, we also examine the Cost-Effectiveness (CE). CE analyses are often overlooked (also in MH programs), yet can provide valuable insights into programs and their impacts (Dhaliwal et al. 2013). We analyze the cost-effectiveness of the *Ritu* program on educational outcomes, which is especially informative since one treatment arm (the school program) was considerably more costly than the other (combined program). Our findings show that the school program was considerably more cost-effective than the combined program, both when measured in 'additional years of schooling' and 'learning-adjusted years of schooling'. It is important to note that CE analyses rely on many assumptions and should not be taken out of context. Our CE estimates should be interpreted as lower bound estimates of the CE of the program, given they could not take the long-term impact into account nor account for effects beyond educational outcomes (such as psychosocial outcomes). Though conservative, our CE estimates still fall in the same range as other programs in Bangladesh with similar beneficiaries. These findings provide additional support for the claim that policymakers aiming to increase schooling, should not overlook the potential of more holistic programs such as MH programs. To the best of our knowledge, we are the first to rigorously test the cost-effectiveness of an MH program, and future research could add to the evidence base so that MH programs can be compared to each other.

The holistic and inclusive approach of the *Ritu* program was crucial to its success, and resulted in significant and positive treatment effects on all our main outcomes of interests. The results should thus be seen as the joint effect of all the different program aspects, and cannot be interpreted in isolation. However, from a policy perspective is it important to know at which level a program should be implemented. Therefore, we tested two versions of the program; one administered at school level, and one at both the school and the household level. This allows us to isolate the additional effect of the targeted household component. We find that the additional effect of the relatively

costly household component is modest, for most outcomes the difference in treatment effects with the school program is insignificant. These findings have important policy implications, since menstrual health programs often rely on a household or community component. Our results show that a well-targeted comprehensive program administered at school level, leads to similar outcomes for less costs.

8 Conclusion

Even though menstrual health programs are becoming more prevalent, evidence on the impact is limited. We analysed two versions of a MH program, one implemented at school level and one implemented at school and household level. Our analysis provides insights on how a comprehensive approach with investments in toilet facilities, as well as provision of MH education and support, can lower barriers towards education and personal development of adolescents.

Our findings have important policy implications, not only within Bangladesh but also in other lower-income countries facing similar MH challenges; poor toilet facilities, lack of knowledge and support, and cultural restrictions. First, we contribute to the literature by being the first to report robust positive treatment effects on school absence rates of both boys and girls, using a rigorous randomized approach. A shortcoming of the current study is that we lack detailed data on boys and cannot rigorously analyse the exact channel through which the program affected boys and their barriers to education. Future studies could delve deeper into the exact channels through which MH programs affect boys. Second, menstrual health programs are relatively new and the evidence base is scarce when it comes to direct quantitative impact on MH outcomes such as practices, beliefs and support systems. We add to the literature by reporting on an extensive set of MH outcomes that should be included when measuring the holistic impact of an MH program. Third, we are the first to report on the cost-effectiveness of an MH program, which is an important factor when making policy decisions. Fourth, we find strong evidence that the targeted household component only had a modest additional effect compared to the school program alone - which is important given the substantial additional costs of a household

intervention, and because other MH programs often rely on household components as well.

The school-based MH program can be relatively easily and sustainably scaled up in Bangladesh due to two reasons, i) the menstrual health education module is tailored to the Bangladeshi school curriculum and can be integrated in all junior secondary schools, ii) the method of constructing and the maintenance of menstrual health-friendly toilet facilities at schools is cost-efficient since it uses existing government resources allocated for these purposes, and relies on school boards to keep facilities clean. Whilst highly effective at improving development outcomes for adolescents in Bangladesh, this program is likely to be less cost-effective in other countries since budgets for toilet facilities in schools are probably not as readily available.

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A. Appendix

a. Randomization check: baseline balance of school characteristics

TABLE A - 1
School Characteristics Per Treatment Arm at *t=0*

VARIABLE	VARIABLE DESCRIPTION	TREATMENT I	TREATMENT II	CONTROL	P-VALUE*
Aggregate school attendance	Binary 1(low)2 (high)	1.54	1.56	1.51	(0.881)
School toilet facilities	Binary score of quality and quantity combined. 1(low) 2 (high)	1.30	1.25	1.28	(0.850)
Upazila (sub-district)	Breakdown per sub-district:				(0.937)^
	% schools in Upazila 1**	18%	15%	13%	
	% schools in Upazila 2	15%	15%	17%	
	% schools in Upazila 3	21%	28%	25%	
	% schools in Upazila 4	8%	10%	11%	
	% schools in Upazila 5	21%	10%	11%	
	% schools in Upazila 6	8%	10%	13%	
	% schools in Upazila 7	10%	10%	10%	
Total number of schools		39 (100%)	39 (100%)	71 (100%)	n/a

** Kruskal-Wallis test for differences between treatment arms, with ties ^ Kruskall-Wallis test on the aggregate Upazila variable (range 1-7)*
*** For simplicity, we numbered the Upazila names., exact Upazila names are available upon request*

b. Overview of main outcomes and data collection time points

TABLE A - 2
Outcome measures and data collection time points

	Rolling basis	**Baseline (t=0) 2017**	**Endline (t=2) 2019**
1. Program effect outcomes			
MH-friendly toilet facilities at school		√	√
MH knowledge		√	√
MH Normative beliefs and expectations			√
MH supportive environment		√	√
2. Primary impact outcomes			
Educational outcomes			
School attendance (school records)	√		
School attendance (spot-check data)	√		
School attendance (self-reported, survey data)		√	√
Psychosocial outcomes			
General psychosocial wellbeing		√	√
Psychosocial wellbeing during menses		√	√
Empowerment			
General empowerment		√	√
Empowerment during menses		√	√
3. Secondary impact outcomes			
Menstrual Health			
MH practices		√	√
MH open communication		√	√

c. Education: treatment effects on school absence rates of pre-menarche girls

TABLE A - 3

School absence of pre-menarche girls

Three data sources: school records, survey and spot-check data

School Absence Rates – Girls with no menarche

	School records		Survey		Spot-check	
	(1)	(2)	(3)	(4)	(5)	(6)
T1: School program	-0.040	-0.032	0.016	0.013	-0.005	-0.024
	(0.038)	(0.037)	(0.032)	(0.028)	(0.045)	(0.045)
T2: School + HH program	0.015	0.014	0.002	0.006	0.043	0.032
	(0.039)	(0.038)	(0.024)	(0.029)	(0.051)	(0.050)
Control Mean	0.318	0.318	0.147	0.147	0.486	0.486
Observations	333	333	333	333	333	333
Controls^	NO	YES	NO	YES	NO	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: school absence rates of pre-menarche girls in grade 7, calculated using school records data in columns (1) and (2), survey data in column (3) and (4) and spot-check data in column (5) and (6). ^Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

d. Education: boy school absence rates

TABLE A - 4

Treatment effects on boy school absence rates, using school record data

	BOYS GRADE 7 AGGREGATE
	(1)
T1: School Program	-0.101***
	(0.031)
T2: School + HH program	-0.127***
	(0.030)
Control Mean	0.506
Observations	148
Controls ^^	YES
p-value T1=T2^	0.486
Clustered SE	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: school absence rates of grade 7 boys, calculated using school records data. ^ 'p-value T1=T2' tests for equality of coefficients, with the null hypothesis $\beta_{t1} - \beta_{t2} = 0$. ^^ Controls include: stratification variables. We do not have any individual level data on boys; therefore, we could only use school level control variables.*

e. Psychosocial outcomes – regressions without control variables

TABLE A - 5
Psychosocial wellbeing: general, and during menstrual period
Regressions without control variables

	GENERAL		DURING MENSTRUAL PERIOD	
	Mental Health Index (1)	Subj. Wellbeing Index (2)	Embarrass. During MP (3)	Insecure during MP (4)
T1: School program	0.081	-0.060	0.130*	-0.020
	(0.291)	(0.059)	(0.069)	(0.083)
T2: School + HH program	0.381	0.050	0.226***	0.178***
	(0.277)	(0.050)	(0.061)	(0.067)
Control Mean	24.1	5.87	3.30	3.37
Observations	2,127	2,127	2,127	2,127
Controls	NO	NO	NO	NO

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: (1) Mental health index (0-30) the higher the more positive, (2) Subjective Wellbeing Index (0-7), (3) and (4) frequency of feeling embarrassed or insecure during MP (1=always - 4=rarely/never)*

TABLE A - 6
Subjective wellbeing during MP: at school and at home
Regressions without control variables

	AT SCHOOL			AT HOME		
	MHM confidence	Worries changing material	Worries about MP odor	MHM confidence at home	Worries changing material	Worries about MP odor
	(1)	(2)	(3)	(4)	(5)	(6)
T1: School program	0.401***	0.777***	0.132**	0.104	0.075	0.055
	(0.095)	(0.194)	(0.055)	(0.073)	(0.141)	(0.054)
T2: School + HH program	0.517***	0.523**	0.147***	0.173**	0.028	0.073
	(0.094)	(0.218)	(0.053)	(0.080)	(0.119)	(0.053)
Control Mean	3.43	8.6	3.48	4.28	9.3	3.56
Observations	2,073	949	2,064	2,127	2,127	2,127
Controls	NO	NO	NO	NO	NO	NO

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: Perceived confidence in managing MH (range 1-5) in column (1) and (4), Worries about changing material (range 0-10) in columns (2) and (5), Likelihood of worrying about MP odor (range 1-4) in column (3) and (6).*

f. General Empowerment – General Mobility measures

For this measure, we asked all participants about common places they might have visited during the last month; friends within the same village, the market, relatives outside the village, and a religious place. See Table A - 7 for the results. We find small treatment effects, girls report to have visited friends, the market and a religious place, a little more often than girls in the control group. On the other mobility variables, we do no find a treatment effect. In general, it turned out that most girls reported they had not visited the place at all, only about 25% indicated they had been to a certain place. Therefore, this mobility measure is not representative for capturing mobility levels of the program beneficiaries.

TABLE A - 7

General empowerment: logit estimates of general mobility measures

	VISIT FRIENDS	**VISIT MARKET**	**VISIT RELATIVES**	**VISIT RELIGIOUS PLACE**
	(1)	(2)	(3)	(4)
T1: School program	0.376*	0.307**	-0.014	0.356*
	(0.197)	(0.139)	(0.116)	(0.189)
T2: School + HH program	0.116	0.338**	0.015	0.022
	(0.190)	(0.159)	(0.121)	(0.213)
Constant	0.695	-1.015	0.908	-0.083
Observations	2,095	2,095	2,095	2,095
Controls^	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: binary variables 1 (Yes, visited in last month) 0 (No, did not visit last month. ^ Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

g. General Empowerment – sub indices

A. *Empowerment sub-index: Gender Attitudes, regression estimates*

TABLE A - 8

Empowerment sub- index: Gender Attitudes index components

PANEL A	**EQ 1^**	**EQ 2**	**EQ 3**	**EQ 4**	**EQ 5**	**EQ 6**	**EQ 7**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
T1: School program	-0.011	0.039	0.019	-0.152	0.076	-0.056	0.123
	(0.175)	(0.202)	(0.152)	(0.202)	(0.180)	(0.281)	(0.173)
T2: School + HH program	0.321*	0.502**	0.099	0.252	0.405**	0.114	0.211
	(0.191)	(0.205)	(0.150)	(0.197)	(0.189)	(0.268)	(0.178)
Constant	0.642	0.843	0.846	1.162	-0.118	3.444**	-2.477***
Observations	2,084	2,095	2,095	2,095	2,095	2,074	2,095
Controls	YES	YES	YES	YES	YES	YES	YES
PANEL B	**EQ 8**	**EQ 9**	**EQ 10**	**EQ 11**	**EQ 12**	**EQ 13**	
	(8)	(9)	(10)	(11)	(12)	(13)	
T1: School program	0.022	-0.309	0.239	0.123	0.065	0.101	
	(0.288)	(0.293)	(0.196)	(0.189)	(0.296)	(0.250)	
T2: School + HH program	0.076	0.347	0.278	0.081	0.430	0.571**	
	(0.255)	(0.343)	(0.194)	(0.189)	(0.323)	(0.287)	
Constant	4.760***	1.099	2.403**	1.052	-3.207**	5.351***	
Observations	2,095	2,073	2,090	2,095	2,095	2,095	
Controls	YES	YES	YES	YES	YES	YES	

*Notes: Logit estimates. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. ^ Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household. see Table below for binary dependent variable details.*

Var. name	**Equality variable**	**Outcomes**
EQ 1	*A girl should not expect to inherit her father's property*	*1 (not at all true) 0 (somewhat/mostly/completely true)*
EQ 2	*It's more important for boys to get an education than it is for girls*	*1 (not at all true) 0 (somewhat/mostly/completely true)*
EQ 3	*Girls should have just the same chance to work outside the home as boys*	*1(completely true) 0 (somewhat/mostly/not at all true)*
EQ 4	*Boys should have more free time than girls.*	*1 (not at all true) 0 (somewhat/mostly/completely true)*
EQ 5	*At home boys should always eat first.*	*1 (not at all true) 0 (somewhat/mostly/completely true)*
EQ 6	*The higher the earnings of the boy the more he deserves to get dowry*	*1 (not at all true) 0 (somewhat/mostly/completely true)*
EQ 7	*A girl who disagrees with her brother in public is impolite*	*1 (not at all true) 0 (somewhat/mostly/completely true)*
EQ 8	*Girls should be sent to school only if they are not needed to help at home.*	*1 (not at all true) 0 (somewhat/mostly/completely true)*
EQ 9	*Giving dowry to a girl is more important than investing in her education.*	*1 (not at all true) 0 (somewhat/mostly/completely true)*
EQ 10	*It is better to be a man than to be woman*	*1 (not at all true) 0 (somewhat/mostly/completely true)*
EQ 11	*Girls should be allowed to wear whatever they want without being harassed*	*1(completely true) 0 (somewhat/mostly/not at all true)*
EQ 12	*Latest age girl should marry*	*1 (19 years or older) 0 (18 years and younger)*
EQ 13	*Preferred son-daughter ratio*	*0 (ratio>1) 1(ratio=1) 2 (ratio<1)*

B. Empowerment sub-index: Opinions & Decisions, regression estimates

TABLE A - 9

Empowerment sub-index: opinions & decisions index components

	O&D 1	O&D 2	O&D 3	O&D 4	O&D 5	O&D 6	O&D 7
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
T1: School program	0.007	0.072	0.196	-0.132	-0.037	0.397	0.395*
	(0.254)	(0.225)	(0.169)	(0.179)	(0.152)	(0.296)	(0.202)
T2: School + HH program	0.450*	0.252	0.316	0.064	0.424***	0.165	0.760***
	(0.244)	(0.241)	(0.205)	(0.184)	(0.157)	(0.317)	(0.256)
Constant	-2.846**	-2.370*	-1.837*	-2.458**	0.828	-1.499	-0.081
Observations	2,095	2,095	2,095	2,095	2,095	2,095	1,734
Controls	YES	YES	YES	YES	YES	YES	YES

*Notes: Logit regression. Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. ^^ Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household. ^see Table below for binary dependent variable details*

Var. name	Opinions & decisions variable	Outcomes
O&D 1	*I feel free to decide for myself how to lead my life.*	*1(completely true) 0 (somewhat/mostly/not at all true)*
O&D 2	*I generally feel free to express my ideas and opinions at home*	*1(completely true) 0 (somewhat/mostly/not at all true)*
O&D 3	*I generally feel free to express my ideas and opinions amongst friends*	*1 (completely true) 0 (somewhat/mostly/not at all true)*
O&D 4	*I generally feel free to speak up in class or raise my hand*	*1(completely true) 0 (somewhat/mostly/not at all true)*
O&D 5	*I think I will be allowed to say no to a marriage proposal*	*1 (yes) 0 (no)*
O&D 6	*I have tried to negotiate with my parents about getting married*	*1 (yes) 0 (no)*
O&D 7	*I think I will be allowed to continue my education after I'm married*	*1 (yes) 0 (no)*

C. Empowerment sub-index: Aspiration, regression estimates

In a region where most married girls drop out of school immediately, and the average age of marriage is 15.4(Bangladesh Demographic and Health Survey, 2014), being allowed to continue studying after marriage could have tremendous impact on the rest of a girl's life. Regarding the aspired age of marriage (part of the aspiration index), we find that girls in the control group report a preferred age of marriage of 21.9, which is substantially higher than the average age of marriage in the study area (15.4 years) (Bangladesh Demographic and Health Survey, 2014). We find a significant treatment effect of the combined program; increasing the desired age of marriage to 22.5 years. In the study area it is common for parents to arrange their daughter's marriage – it is therefore not surprising that we find a significant treatment effect of the combined program (which specifically targets parents) and not of the school program (which does not interact with parents directly).

TABLE A - 10

Empowerment sub-index: Aspiration index

The logit estimates of the two variables of the aspiration index

	ASPIRED EDUCATION LEVEL^	DESIRED MARRIAGE AGE^
	(1)	(2)
T1: School program	0.267	-0.129
	(0.184)	(0.134)
T2: School + HH program	0.204	0.355**
	(0.249)	(0.167)
Constant	2.206	-2.262
Observations	2,084	2,095
Controls^	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Binary dependent variablse: 0 if below median split (bachelor degree or lower), 1 if above (master degree and higher) ^ Controls in each regression include: stratification variables and, age at menarche, distance to school, household composition (presence of grandparents, father, mother and/or brothers), toilet characteristics at baseline, baseline levels of subjective wellbeing and household progress out of poverty index (PPI), and number of female role models in household.*

h. Heterogeneity results

To keep the heterogeneous analyses concise, we do not report the heterogeneous effects on all our outcome variables (i.e. dependent variables). Rather, we selected one variable per main outcome category; education, psychosocial wellbeing and empowerment. For educational outcomes, we report on general school absence (using school record data) and school absence during menses (using the survey question "how often do you miss school due to being on your period?"). For general psychosocial wellbeing, we report on the mental health index. For psychosocial wellbeing during menses, we report on the frequency of feeling embarrassed during menses. For empowerment, we report on the empowerment index.

1) Heterogeneous results for pre-program gender equity levels

TABLE A - 11

Heterogeneous results: Pre-program gender equity levels

	SCHOOL ABSENCE		**PSYCHOSOCIAL WELLBEING**	
	GENERAL	DURING MP	GENERAL	DURING MP
	(1)	(2)	(3)	(4)
Gender equity * T1	0.000	-0.229**	0.264	0.271***
	(0.027)	(0.110)	(0.336)	(0.082)
Gender equity *T2	0.008	-0.071	0.402	0.080
	(0.035)	(0.109)	(0.332)	(0.084)
Gender equity^	0.013	0.094	0.188	-0.036
	(0.020)	(0.084)	(0.207)	(0.059)
T1 (School program)	-0.101***	-0.132	-0.032	-0.004
	(0.029)	(0.109)	(0.376)	(0.085)
T2 (School + HH program)	-0.076**	-0.288***	0.244	0.191**
	(0.034)	(0.106)	(0.291)	(0.074)
Constant	0.394***	1.712***	23.566***	3.492***
	(0.054)	(0.174)	(0.560)	(0.139)
Observations	1,985	1,646	2,127	2,127
Controls^^	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variable: school absence rate girls grade 7 using school record data (column 1), self-reported school absence during menstrual period (column 2), Mental health index (0-30) the higher the more positive (column 3) , frequency of feeling embarrassed during MP (1=always - 4=rarely/never). ^ binary value 1= high gender equity at baseline, 0=low gender equity at baseline ^^ Controls in each regression include: stratification variables.*

2) Heterogeneous results for pre-program educational aspiration

TABLE A - 12

Heterogeneity: Pre-program educational aspiration

	SCHOOL ABSENCE		PSYCHOSOCIAL WELLBEING	
	GENERAL	DURING MP	GENERAL	DURING MP
	(1)	(2)	(3)	(4)
Aspiration * T1	0.017	0.122*	0.398	0.235***
	(0.018)	(0.064)	(0.262)	(0.058)
Aspiration * T2	0.025	-0.070	0.525**	0.044
	(0.029)	(0.073)	(0.255)	(0.058)
Aspiration^	-0.030**	-0.079*	0.483***	-0.003
	(0.012)	(0.041)	(0.127)	(0.035)
T1 (School program)	-0.110***	-0.243**	-0.090	0.015
	(0.027)	(0.098)	(0.355)	(0.078)
T2 (School + HH program)	-0.083**	-0.378***	0.155	0.210***
	(0.032)	(0.098)	(0.264)	(0.065)
Constant	0.409***	1.736***	23.534***	3.474***
	(0.052)	(0.157)	(0.523)	(0.136)
Observations	1985	1,771	2,127	2,127
Controls	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variable: school absence rate girls grade 7 using school record data (column 1), self-reported school absence during menstrual period (column 2), Mental health index (0-30) the higher the more positive (column 3) , frequency of feeling embarrassed during MP (1=always - 4=rarely/never). ^Aspiration: binary value 1 (high aspiration at baseline) or 0 (low aspiration at baseline) ^^ Controls in each regression include: stratification variables.*

3) Heterogeneous results for pre-program household poverty level

We used the Progress out of Poverty Index (PPI) method from Schreiner (2013) to estimate the poverty likelihood per household. This method provides a PPI score, which is then collapsed into categories of five to estimate the poverty likelihood (eg. 0-4, 5-9 etc.). On average, our sample of girls had a PPI score of 54 (SD 13.6), indicating the mean likelihood of 60.3% that the household wealth lies below the international poverty line of $1.75 (2005 PPP). We did not find evidence that girls from wealthier backgrounds (higher poverty index scores) had a substantially different treatment effect than girls from less wealthy households (Table A - 13).

TABLE A - 13

Heterogeneity: pre-program wealth level household

	SCHOOL ABSENCE	PSYCHOSOCIAL WELLBEING		EMPOWERMENT
		GENERAL	DURING MP	
	(1)	(2)	(3)	(4)
Wealth * T1	-0.003	-0.024*	0.000	-0.001
	(0.004)	(0.013)	(0.003)	(0.001)
Wealth * T2	-0.007*	-0.000	-0.002	-0.000
	(0.004)	(0.012)	(0.003)	(0.001)
Wealth	-0.000	0.015*	0.004*	0.001***
	(0.003)	(0.008)	(0.002)	(0.000)
T1: School program	-0.459**	1.403*	0.122	0.053
	(0.215)	(0.745)	(0.159)	(0.036)
T2: School + HH program	-0.746***	0.434	0.326*	0.074**
	(0.203)	(0.699)	(0.176)	(0.031)
Constant	1.755***	22.885***	3.281***	0.442***
	(0.196)	(0.667)	(0.171)	(0.033)
Observations	1,771	2,127	2,127	1,735
Controls	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: self-reported school absence girls grade 7 (column 1), Mental health index (0-30) the higher the more positive (column 2) , frequency of feeling embarrassed during MP (1=always - 4=rarely/never)in column (3), Empowerment index (range 0-1) (column 4) ^Wealth: continuous PPI score (0-100) ^^ Controls in each regression include: stratification variables.*

4) Heterogeneous results for pre-program menarche

TABLE A - 14

Heterogeneity: pre-program menarche

	SCHOOL ABSENCE	PSYCHOSOCIAL WELLBEING		EMPOWERMENT
		GENERAL	DURING MP	
	(1)	(2)	(3)	(4)
Pre-menarche * T1	-0.010	0.073	-0.115	0.001
	(0.102)	(0.304)	(0.088)	(0.016)
Pre-menarche * T2	0.151	0.141	-0.109	0.009
	(0.103)	(0.313)	(0.079)	(0.017)
Pre-menarche^	-0.024	-0.124	0.035	0.003
	(0.078)	(0.205)	(0.056)	(0.012)
T1: School program	-0.240**	0.068	0.175**	0.011
	(0.100)	(0.282)	(0.075)	(0.016)
T2: School + HH program	-0.383***	0.392	0.275***	0.049**
	(0.090)	(0.294)	(0.068)	(0.020)
Constant	1.777***	23.702***	3.455***	0.509***
	(0.171)	(0.519)	(0.136)	(0.030)
Observations	1,646	2,127	2,127	1,735
Controls^^	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: self-reported school absence girls grade 7 (column 1), Mental health index (0-30) the higher the more positive (column 2) , frequency of feeling embarrassed during MP (1=always - 4=rarely/never) in column (3), Empowerment index (range 0-1) (column 4). ^ pre-menarche is binary variable with 1(yes, menarche before the Ritu program started (pre-program)) and 0 (no, no menarche pre-program) ^^ Controls in each regression include: stratification variables.*

5) Heterogeneous results for girls with grandparents in their household

TABLE A - 15

Heterogeneity: grandparents within household

	SCHOOL ABSENCE	PSYCHOSOCIAL WELLBEING		EMPOWERMENT
		GENERAL	DURING MP	
	(1)	(2)	(3)	(4)
Grandparents * T1	-0.070	0.326	0.097	-0.033
	(0.121)	(0.405)	(0.087)	(0.022)
Grandparents * T2	0.020	-0.730*	0.077	-0.008
	(0.119)	(0.373)	(0.089)	(0.021)
Grandparents^	-0.048	0.113	-0.077	0.001
	(0.085)	(0.218)	(0.062)	(0.014)
T1: School program	-0.231***	0.033	0.113	0.019
	(0.088)	(0.298)	(0.069)	(0.015)
T2: School + HH program	-0.328***	0.576**	0.217***	0.056***
	(0.087)	(0.274)	(0.060)	(0.018)
Constant	1.776***	23.634***	3.487***	0.510***
	(0.165)	(0.535)	(0.140)	(0.029)
Observations	1,646	2,127	2,127	1,735
Controls	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: self-reported school absence girls grade 7 (column 1), Mental health index (0-30) the higher the more positive (column 2) , frequency of feeling embarrassed during MP (1=always - 4=rarely/never) in column (3), Empowerment index (range 0-1) (column 4). ^ grandparents is a binary variables, 1 (yes, 1 or more grandparents within household) 0 (no, no grandparents within household) ^^ Controls in each regression include: stratification variables.*

6) Heterogeneous results for girls with female role models within the household

TABLE A - 16

Heterogeneity: Female role models in household

	SCHOOL ABSENCE	PSYCHOSOCIAL WELLBEING		EMPOWERMENT
		GENERAL	DURING MP	
	(1)	(2)	(3)	(4)
Female role models * T1	-0.066	0.418	0.074	-0.007
	(0.093)	(0.337)	(0.077)	(0.018)
Female role models * T2	0.015	0.365	-0.024	-0.009
	(0.093)	(0.305)	(0.082)	(0.018)
Female role models^	0.005	-0.048	0.016	0.002
	(0.060)	(0.164)	(0.057)	(0.010)
T1: School program	-0.215**	-0.088	0.099	0.014
	(0.091)	(0.318)	(0.079)	(0.016)
T2: School + HH program	-0.330***	0.287	0.243***	0.060***
	(0.090)	(0.276)	(0.062)	(0.017)
Constant	1.764***	23.687***	3.461***	0.509***
	(0.164)	(0.529)	(0.139)	(0.029)
Observations	1,646	2,127	2,127	1,735
Controls^^	YES	YES	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: self-reported school absence girls grade 7 (column 1), Mental health index (0-30) the higher the more positive (column 2) , frequency of feeling embarrassed during MP (1=always - 4=rarely/never) in column (3), Empowerment index (range 0-1) (column 4). ^Female role models is a binary variable 1 (more than 1 fem. role model) and 0 (no fem. role model), where female role model is defined as any older female siblings, mothers or grandmothers living in the same household as the girl.^^ Controls in each regression include: stratification variables.*

7) Heterogeneous results: pre-program psychosocial wellbeing

TABLE A - 17

Heterogeneity: pre-program psychosocial wellbeing

	SCHOOL ABSENCE	EMPOWERMENT
	(1)	(2)
Psychosocial wellbeing * T1	0.022	0.021
	(0.118)	(0.017)
Psychosocial wellbeing * T2	-0.086	-0.005
	(0.110)	(0.020)
Psychosocial wellbeing^	0.167**	-0.010
	(0.083)	(0.012)
T1: School program	-0.262***	0.006
	(0.094)	(0.017)
T2: School + HH program	-0.295***	0.056***
	(0.088)	(0.021)
Constant	1.735***	0.513***
	(0.167)	(0.029)
Observations	1,646	1,735
Controls^^	YES	YES

*Notes: Robust standard errors in parentheses adjusted for clustering at school level. *** p<0.01, ** p<0.05, * p<0.1. Dependent variables: self-reported school absence girls grade 7 (column 1), Empowerment index (range 0-1) (column 2). ^ Psychosocial wellbeing is a binary variable, 1 (high level of pre-program psychosocial wellbeing) 0 (low level of pre-program psychosocial wellbeing). ^^ Controls in each regression include: stratification variables.*

i. Cost-effectiveness evidence in Bangladesh: comparison of rigorous studies that reported cost-effectiveness outcome on additional years of schooling for adolescent girls in Bangladesh

TABLE A - 18

Outcome measure		**Program details**	**CE Findings** *Outcome per $1000 spent in Bangladesh*
Additional years of schooling	(Buchmann et al., 2018)	Conditional oil incentive to delay marriage	4.31
	(Buchmann et al., 2018)	Empowerment program	4.30
	(Hahn et al., 2018)	Conditional Cash Transfer (FSSAP)^ to increase school attendance	0.15
	(Hong, S. Y., & Sarr, 2012)	Conditional Cash Transfer (FFSAP) to increase school attendance	2.45
	(Hong, S. Y., & Sarr, 2012)	Free tuition policy to increase school attendance	0.00^^
Additional LAYS	(Buchmann et al., 2018)	Conditional oil incentive to delay marriage	*2.54*
	(Buchmann et al., 2018)	Empowerment program	*2.53*
	(Hahn et al., 2018)	Conditional Cash Transfer program (FSSAP) to increase school attendance	*0.09*
	(Hong, S. Y., & Sarr, 2012)	Conditional Cash Transfer program (FFSAP) to increase school attendance	*1.44*
	(Hong, S. Y., & Sarr, 2012)	Free tuition policy to increase school attendance	*0.00*

^Female Secondary School Assistance Program (FFSAP). ^^ Program did not have a significant impact on additional years of schooling, hence CE is zero