Randomized impact evaluations: Measuring socio-economic impact and cost-effectiveness of development interventions

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SERIES ACADEMIC NETSPAR

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Evidence on improving the lives of adolescent girls in Bangladesh through menstrual health interventions

By Lidwien Sol

Acknowledgements

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Chapter 1

Introduction

Helping others comes natural to most people, globally people gave USD 68 billion to charity in 2018 (Global Philanthropy Tracker, 2020). Together with the three other sources of development funds (remittances, official development assistance and impact investments) the total amount of philanthropic outflows amounted to USD 834 billion in 2018 (Global Philanthropy Tracker, 2020). 834 *billion* dollars is a heartwarming amount, but how much did it accomplish? Our hearts want to believe that good intentions behind these outflows, guarantee positive impact on the ground. But we need our heads to ask the difficult questions; how much positive change have these dollars had? Could we have helped even more people had we allocated the money to different regions, or different people, or different programs? Combing the head with the heart is tricky but crucial if we are serious about global development and leaving no one behind.

In an ambitious attempt to help keep track of global development, the United Nations adopted 17 goals with 169 targets - the Sustainable Development Goals (SDGs) - as a call to achieving a better and more sustainable future for all by 2030. For example, SDG 1 is to end poverty in all its forms, everywhere. The world is a long way from reaching the SDGs but measuring what works and what does not, is an important step and will help us achieve the goals sooner. One way to measure the true impact of philanthropic efforts, is to break the problem down in small puzzle pieces and see what works under strict experimental designs: e.g. Randomized Controlled Trials (RCTs). RCTs allow us to understand the exact pathways of how investments and/or interventions lead to impact and if this impact is larger for certain people than others, or more beneficial in certain settings than elsewhere. Once we know what works in small-scale controlled settings, we can test how it works in large scale. RCTs are generally considered the gold standard for impact evaluations, they provide rigorous causal evidence but also require much money and time and they are not needed in all

areas of development. RCTs are most needed in areas where the existing evidence is scarce, and the need for improvement is high.

One such area is economic development of girls and women and the strive for gender equality around the globe. Gender equality and the full participation of women in all levels of society and all levels of decision-making is a basic human right. That alone is reason enough to promote gender equality, but there is also another compelling argument: women play a crucial part in the socio-economic development of countries (Duflo, 2012). Gender equality and economic development are closely related; they both affect each other. In one direction, discriminating against women hinders economic development (Duflo, 2012). In the other direction, economic development has the potential power to reduce gender inequality. We see that disparities in health, education and autonomy tend to be larger for countries with lower income levels and economic development (Jayachandran, 2015). Economic prosperity cannot close these gender gaps on its own though, it has deep roots in society too. The US is a prime example of how economic prosperity alone is not enough to reach gender equity; a high-income country where abortion rights have recently been revoked.

Gender equality is not a new issue, and by now it is well-known that women often face lifelong barriers to obtaining similar levels of education, income and health (Bertrand et al., 2015; Jayachandran, 2015). Women also face more gender-based violence and have less autonomy compared to their male counterparts (Jayachandran, 2015). Policymakers often focus on targeting issues related to poverty, learning opportunities, labor market participation and political participation of women, when wanting to tackle gender inequality. While reducing poverty, increasing girl's education and providing better labor market opportunities for women reduces gender inequality, persistent social norms and stereotypes still inhibit the full potential of women and thereby hinder economic development (Duflo, 2012; Alesina et al., 2013; Bertrand et al., 2015). One topic often overlooked in the gender equality and development debate, is menstrual health. Menstrual health is a state of complete physical, mental and social wellbeing in relation to the menstrual cycle (Hennegan et al., 2021). Menstrual health is associated with many factors lying at the roots of gender

inequality; social norms, disparities in education, health and labor market participation, and economic development. Access to basic menstrual health services is a rather neglected issue compared to other sources of gender inequality, which is a shame since improving menstrual health has the potential to decrease gender inequality, stimulate socio-economic development and enforce basic human rights.

Menstrual Health

300 million[1] women and girls menstruate on any given day, yet they often lack basic facilities, products and information to safely manage their periods. They face a multitude of barriers, from financial constraints to societal norms and attitudes that restrict their mobility. Higher-income countries tend to focus on combatting issues related to 'period poverty', with some European countries abolishing taxes on menstrual products, and New Zealand providing free products in schools[2]. Yet, barriers to menstrual health go further than financial constraints alone, and especially in lower-income countries issues with sanitary facilities are prevalent, as well as issues with deeply entrenched social attitudes and taboos (Chandra-Mouli and Patel, 2017). This leads to serious exclusion that may include not being allowed to touch certain foods, to missing school and work, or not even being allowed to sleep inside your own home (Sumpter and Torondel, 2013).

Improving menstrual health has the potential to not only positively impact women's wellbeing during menstrual days, but also have broader benefits such as improvements in education, income, mobility, general health and reduce gender-based violence. Boys and men are a crucial aspect of the social barriers that women face during menstruation, and by impacting the knowledge and life skills of boys and men too, menstrual health programs have the potential to build a culture of respect and improve lives of men and women alike.

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[1] *The Lancet (2018). Normalising menstruation, empowering girls. Editorial. Retrieved from:*
https://www.thelancet.com/journals/lanchi/article/PIIS2352-4642(18)30143-3/fulltext

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

Issues related to menstrual health have long been overlooked, for example menstrual health is not even defined as a target in the SDGs. Fortunately, the potential unlocked by improving menstrual health is gaining attention around the world. For example, during the 50th session of the Human Rights Panel in 2022, the World Health Organisation called for i) the recognition of Menstrual Health as a human right, ii) to make sure everyone who menstruates has access to adequate products, information and support and iii) that the impact of these actions is measured. With the importance of improving menstrual health more in the spotlight and more funds flowing to address these issues, it is important to build an evidence base on what works and what does not. This thesis provides evidence and proposes methodologies which could help policymakers, NGOs and impact investors understand the true impact of their investments and programs and improve the lives of girls and women everywhere.

Menstrual barriers in Bangladesh

In this dissertation, I examine the impact and cost-effectiveness of providing menstrual health support to adolescent girls in Bangladesh. I look at how their lives are improved and the effect it has on their peers and parents. Bangladesh has a population of 166 million, in recent years it has shown a steady annual GDP growth and the percentage of population living in poverty[3] has decreased from 34.2% in 2000 to 14.3% in 2016 (World Bank). Despite economic progress, Bangladesh consistently scores low in terms of gender equality. The gender schooling gap has come down in recent years, but is still large – with a female to male ratio of 0.77 in 2020 (World Bank). In terms of water and sanitation facilities (vital for menstrual health), only 39% of the population has access to safely managed sanitation services in 2020 and 59% had access to safely managed drinking water although there are large differences between urban areas (with more access to water and sanitation services) than rural areas (World Bank).

Traditionally, Bangladesh is a country with strong norms and beliefs about menstruation and negative attitudes towards menses. Women and girls are severely

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[3] % of population living below 1.90$ PPP(2011)

hampered in their freedom and agency, which leads to poor menstrual health and lower overall wellbeing. Menstrual barriers in Bangladesh broadly fall into three categories; i) lack of products and facilities, ii) lack of information and communication, iii) restrictive menstrual taboos. For example, they lack access to sanitary facilities, have not been taught properly about menstrual health, and they live in a culture where menstruation is often seen as dirty and shameful and face many restrictions on their movement during menses. Menstrual health programs aim to reduce these barriers and provide girls and women with the knowledge, tools and skills to practice safe menstrual health. However, evidence on the effectiveness of menstrual health programs is scarce, and there is a need for more rigorous evaluations to be able to assess the effectiveness of MH programs (Hennegan and Montgomery, 2016).

The impact of menstrual health interventions

In this dissertation I examine the impact of the *Ritu* program, a program run by Simavi (a non-governmental organisation). The program aimed to improve the menstrual health, wellbeing and personal development of girls in Bangladesh, by reducing menstrual barriers. The program ran from 2017-2019 in Netrakona district in Bangladesh and provided adolescent girls with tools, knowledge and support they need to manage their menstrual health safely and confidently. This was done by facilitating improved sanitary facilities at schools, providing menstrual health

FIGURE 1 - 1
Simplified Theory of Change
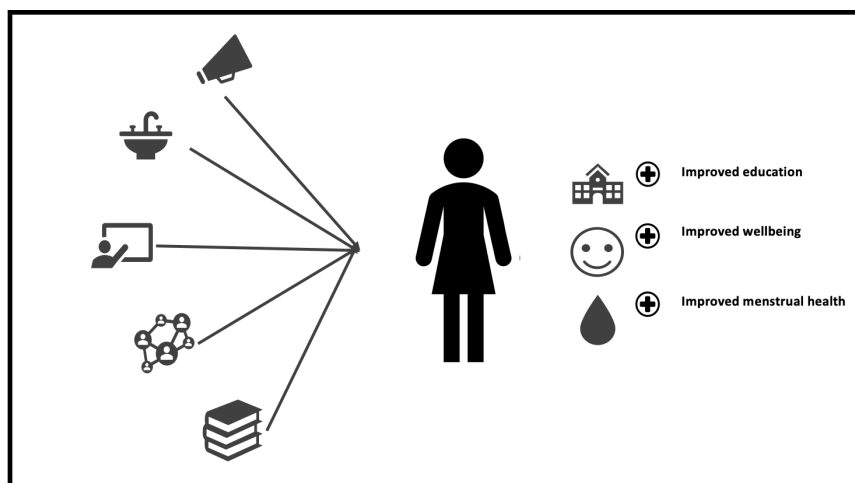
education to girls, their male peers and their parents, and challenging prevailing restrictive norms and attitudes towards menstruation. There were two versions of the program, one version ('school program') solely took place at schools and the other version ('combined program') took place in both the schools and at household level. In total, the program targeted 15,000 girls from 78 different schools, and their peers and parents. Figure 1 - 1 shows a simplified model of the theory of change; the Ritu program involved a school campaign, construction of MH-friendly toilet facilities in schools, teachers teaching about MH in class, a take-home MH module, and parents receiving MH education in their communities.

In this dissertation I use several experimental methodologies to assess the impact and cost-effectiveness of the *Ritu* program. I use five broad research objectives. First, I examine if there is short-term impact on menstrual health outcomes such as improvements in MH knowledge, MH practices and support. Second, I examine if girls became more likely to attend school due to the program. Third, I examine if these changes in menstrual health outcomes and behaviour also had an effect on the overall wellbeing of girls, beyond their wellbeing during menstrual days. Fourth, I use several methods to measure if parents changed their attitudes towards their menstruating daughters, or if they still adhere to restrictive societal norms. Finally, I look at the cost-effectiveness of the entire programs, comparing the costs of running the program with the benefits the program generated.

How to measure the impact of a complex program?

FIGURE 1 - 2
Flow Diagram Ritu
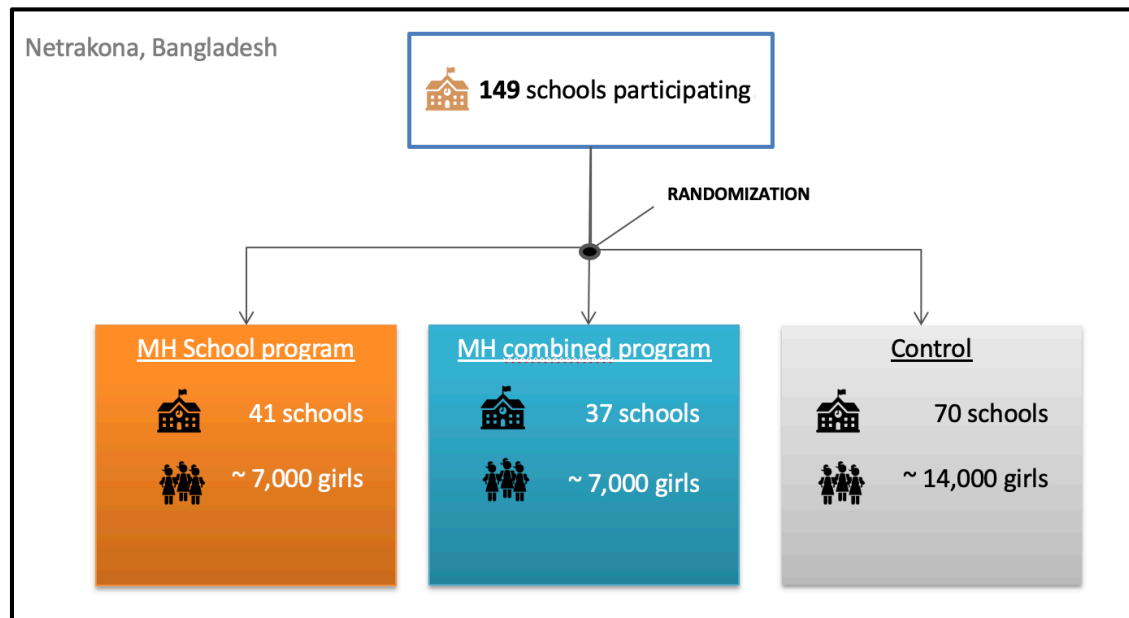
In order to test the impact of the program and reach the five research objectives, we designed an impact evaluation with a Randomized Controlled Trial (RCT) design. RCTs are often used to ascertain the effectiveness of new drugs and medical treatments, where patients are randomly assigned to the treatment group (ie. receiving the drug) or the control group (ie. receiving a placebo), and then the outcomes are compared between the groups to determine if the drug was effective. RCTs have become more prevalent in the social sciences and development work too and the underlying principles are the same. In our case, schools were randomly assigned to receive menstrual health interventions at school, or receive menstrual health interventions at school and at the households of the pupils, or to be in the control group. Since the *Ritu* program is designed to positively affect the lives of girls in many ways, capturing its entire impact is challenging and involves many outcome variables. Our main outcome categories are; menstrual health outcomes, educational outcomes, psychosocial and empowerment outcomes, and attitudinal outcomes. We used mostly primary data sources; we used surveys and administered implicit attitudes tests (to assess the attitudes of parents towards menstruation), we did spot-checks to examine school attendance, and also analyzed school record data. Figure 1 -

2 shows a simplified version of the flow diagram and Figure 1 - 3 shows a map of the research setting and the distribution of schools across treatment groups.

Summary of the chapters

1.1   What is the impact on the lives of girls?

In chapter 1 we focus on measuring the impact of menstrual health interventions on the lives of girls. We test if the theory of change was correct, and use the randomized experimental design to compare outcomes from girls in the treatment groups with the ones in the control group. Rigorous quantitative evidence of menstrual health programs is scarce, and our study addresses this gap in evidence and contributes by examining the comprehensive effects of a menstrual health program on adolescent girls in Bangladesh.

Out of approximately 14,000 girls reached by the program, we took a random sample and surveyed 4172 girls before the program began and we came back two years later to follow up. In this survey we measured outcomes related to menstrual health (ie.

FIGURE 1 - 3
Study area - Netrakona district and distribution of schools
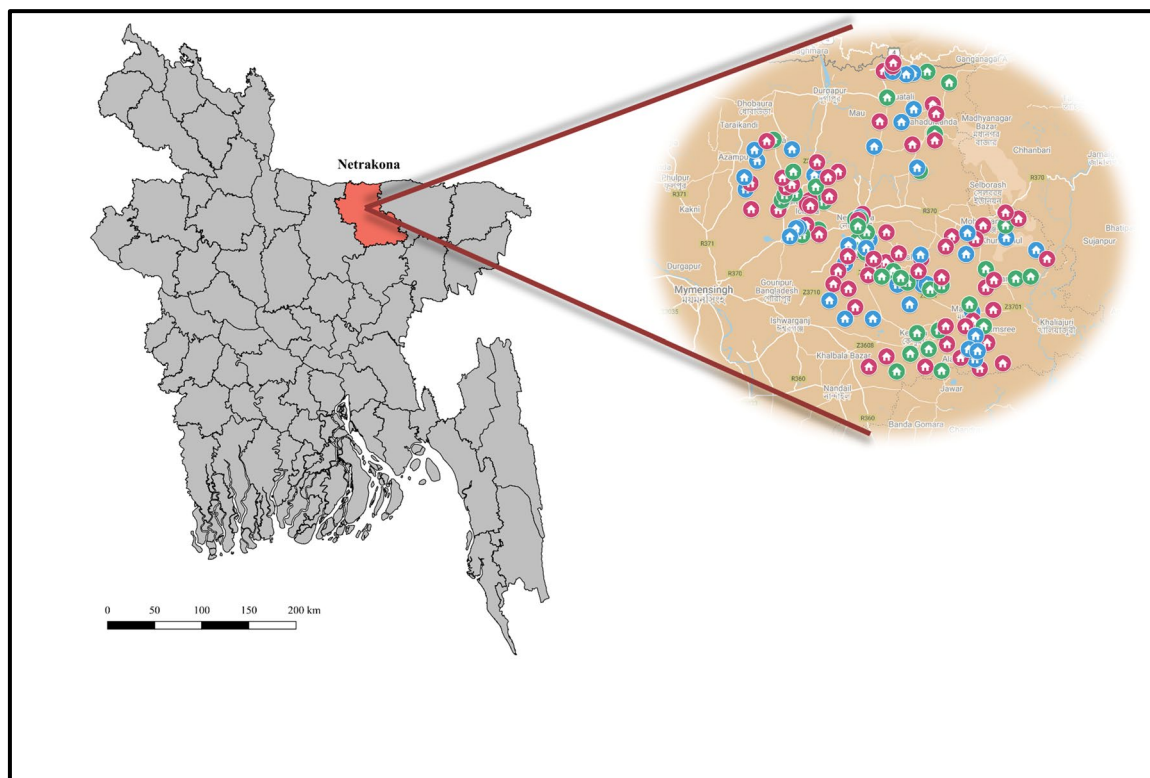
practices, beliefs, support systems, knowledge), a set of psychosocial outcomes (ie. confidence, empowerment, happiness) and self-reported school attendance. Since school attendance is such an important outcome, and one that has consequences for future development outcomes as well, we do not only rely on this self-reported measure but also used two other data sources; we used school records and collected our own data using spot-checks where someone from the research team would appear unannounced at school to check attendance.

Our findings are mostly in line with the theory of change of the program, and we find that the lives of girls were positively affected by the *Ritu* program. Both versions of the program (school program, and combined program) significantly improved menstrual health outcomes, increased school attendance and reduced the likelihood of dropping out of school before grade 8 for girls. The program also improved the wellbeing of girls during their menstrual days, but we did not find significant evidence that this translated to improvements in *general* levels of wellbeing and empowerment. We also tested if the additional household program (as part of the combined program) was much more effective than the school program, but we find little evidence that the additional program generated larger effects than the school program alone on most outcomes.

Menstrual health programs do not only impact menstrual health related outcomes, the multi-faceted approach affects the wellbeing and development of girls in many ways and has positive effects on important determinants for future income and success, such as raising school attendance rates and raising confidence levels. Our study is one of the first to rigorously show the causal link between a menstrual health intervention and positive impact on a range of outcomes. This means that menstrual health programs have the potential to improve development outcomes for girls, and could bring us one step closer to closing the gender gap.

1.2   What is the cost-effectiveness of this menstrual health program?

At the end of chapter 1, we look at how the program's impact compares to the overall costs of implementing the program. It is important to assess the cost-effectiveness of

programs because policymakers or investors have limited funds at their disposal and have to decide where to allocate their money best. Showing positive impact is only one part of the puzzle, we also need to try to compare it to other programs which could also positively affect the lives of girls, and maybe even better. These comparisons can sometimes be heavy on the heart, but we need to make tough choices with our heads in order to reach the goal of the SDGs: create a better and sustainable future for all.

In order to test the cost-effectiveness of the *Ritu* program, we kept detailed track of all expenditures during the program, this allowed us to calculate unit costs (e.g. total costs per school) and to separate the costs between the school program, and the combined program (school and household program). Next, we compared the costs of the program to the impact on school attendance of girls. For cost-effectiveness analyses to be useful for decisionmakers, it is necessary to use a standard outcome measure which could be considered the key objective of many development programs and investments. In the educational sector, school attendance is considered such an outcome and therefore used in most cost-effectiveness analyses (Dhaliwal et al., 2013; Ganimian and Murnane, 2016; Garcia and Saavedra, 2017). Educational outcomes are important for future development, more objective, easily quantifiable, and can be compared across countries. Next to the traditional measure of school attendance, we also use a relatively new measure on education: learning-adjusted years of schooling. This latter measure, corrects for differences in the quality of educational systems across nations.

We find 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 combined program realized similar impact but was much more expensive than the school program alone, and therefore the cost-effectiveness is less.

This is one of the first studies that examined the cost-effectiveness of a menstrual health program, and the first to do so in Bangladesh. We compared our findings to *educational* programs in Bangladesh and find that the *Ritu* program achieves similar results in education – which is remarkable since the program is first and foremost a

menstrual health program, and realized much more impact than the impact on educational outcomes alone. Cost-effectiveness estimates always rely on many assumptions and it is challenging to quantify long term impact. They provide much needed information but they are not exact estimates, they are ball-park figures and should be taken as such. Yet, in our case the cost-effectiveness results clearly show that policymakers should consider menstrual health programs in their decision making since it is not very costly but can be highly beneficial for adolescents and their future.

1.3   Can attitudes towards menstruation change?

In Chapter 3 we turn our attention to the parents of the girls, since they play a vital role in the (menstrual health) behaviour and development of their daughters. The girls do not have full agency of their decisions yet and it is often the parents who impose restrictions on their menstruating daughters. Therefore, we examine in detail whether the menstrual health program succeeded in changing implicit and explicit attitudes of parents towards menstruation and their own menstruating daughters. We also check if certain menstrual taboos were more amenable than others, and if there was a difference in effects on mothers versus fathers, and older versus younger generation parents. Before we could delve into comparing attitudes towards menstruation – we first needed to find a way to measure attitudes towards menstruating to begin with. First, we redefined the abstract term of 'attitude towards menstruation' by examining attitudes towards seven daily activities that are considered taboo for a girl to engage in during her menstruation. These taboos include cooking, playing with friends, going to school, eating white foods, washing cloths and praying.

We tested 250 parents of girls who were part of the combined *Ritu* program, and compared those findings to the ones from 250 parents from girls in the control group. We developed and tested a novel application of an Implicit Attitudes Test to assess individual parental attitudes towards the seven daily activities previously mentioned. Next to these implicit attitudes, we also elicited explicit attitudes and behavior of parents through standard survey questions.

We find that implicit attitudes of parents were not affected by the *Ritu* program, while we do see significant improvements in explicit attitudes and behavior towards their own daughters. Moreover, we find that attitudes towards certain taboos (especially ones rooted in religion) were less malleable than others.

This means that the *Ritu* program managed to achieve a change in conscious preferences and decision making of parents, who were more open to granting their menstruating daughters more freedoms. It might not be surprising that implicit attitudes and strong social norms did not change overnight, since these concepts are deeply rooted in society and might take longer to amend. The important finding is, that *Ritu* set in motion a change in conscious behavior and attitudes of both parents and daughters, who now enjoy more freedoms and agency during their periods. In the long run, this change in behavior might be the start of new dynamics and set in motion changes in deeply rooted preferences, and strong social norms too. Our findings provide some of the first robust evidence on the impact of menstrual health interventions on the attitudes and preferences of parents.

Dissertation outline

In Chapter 2, my co-authors and I look at the impact on several aspects of the girls' lives and examine where the program had the most impact and how the benefits of the program compare to the costs of running it. Understanding where menstrual health support can help women, and the cost-effectiveness of such support compared to other programs, can help other organisations and governments make policy decisions. In Chapter 3, my co-authors and I explore how the menstrual health program has affected the parents of the girls, and their attitudes towards menstruation. Chapter 4 provides a general summary. Lastly, in Chapter 5 I discuss my findings and explore the implications of this research for policymakers, impact investors and non-governmental organisations.

Chapter 2

Breaking down menstrual barriers in Bangladesh

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

This chapter is co-authored by

Eleonora Nillesen (UNU-Merit) and Paul Smeets (University of Amsterdam)

1 Introduction

2 billion women[1] worldwide have to manage their period every month, and this often happens in a secretive and discrete manner. In high-income countries, a move towards open dialogue and combatting 'period poverty' (the lack of access to sanitary products due to financial constraints) 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', women in many low- and middle-income countries also face restrictive norms, social taboos, limited knowledge about menstruation and a lack of proper facilities and products for adequate menstrual health management. As a result, women and girls are often excluded from society during menses and are hindered in their ability to carry out daily activities. In this study, we conduct a clustered randomized controlled trial in rural Bangladesh to examine the impact of a menstrual health program. The program tackled challenges for menstruating girls and aimed to 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 menstrual health (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 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 space to

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[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*

dry wet cloths and a closed bin for used materials (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 during their periods (Sumpter and Torondel, 2013; Tegegne and Sisay, 2014). Policymakers, implementers and researchers alike, have long overlooked how to improve menstrual health in low- and middle-income countries. This is surprising, since MH is associated with at least six[4] out of seventeen Sustainable Development Goals from the United Nations. Programs targeting menstrual health 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 low- and middle-income countries start to widen to the detriment of girls (Muralidharan and Prakash, 2017; Singh and Krutikova, 2017). 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 way to spur 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. Quantitative 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). Girls

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

face many barriers to education, and based on the evidence, menstruation is likely one of them.

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 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). The methodological quality of studies included varied greatly. It is plausible that improvements in MH affect the incidence of reproductive tract infections, but this meta-analysis showed that the strength of the effect, the specific infections and the route of transmission remain unclear. 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 MH programs providing either hardware interventions (providing menstrual resources such as sanitary pads) or software interventions (addressing

psychosocial deficits) and the 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 low-and middle-income countries, 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 MH outcomes and educational, psychosocial and empowerment outcomes in Bangladesh.

Several studies have stressed the gap in quantitative evidence on the causal effects of MH interventions. There is a 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 daily 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). For example, the needs assessment 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 (CE). 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. Much of the CE literature in development focuses on education since the outcomes are important and 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). 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 and not only to MH programs.

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 included 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 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 in 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 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 international 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 in section 4 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 menstruation-related 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 into 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 menstruation-related 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 an 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 group 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 for practicing 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 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

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[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*

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. 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 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 have increased 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 if the program raised their motivation to come to school.

The comprehensive nature of the *Ritu* program affects many aspects of a girl's life. 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, disadvantaged or not, would be equipped with the knowledge, tools and support to manage her menstruation. Still, the effects of the intervention could differ based on pre-program levels of poverty, psychosocial wellbeing, empowerment, and household composition. We therefore also investigate heterogeneity of program effectiveness across these subgroups.

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[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.*

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 bodies[7]. In total, 10.3 million BDT (120,000 USD) was mobilized to construct or upgrade school toilet facilities to gender-segregated 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 designed to fit into the national curriculum of Bangladesh, a curriculum which usually lacks topics on adolescence and menstrual health (Alam et al., 2017). Teachers received a five-day training. The training focused on menstrual education for teachers themselves, didactical skills and incorporation of the MH module into lesson plans, with a specific focus on how to teach culturally sensitive topics. After the training, 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 and reproductive health (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

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

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 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 at school. The sessions were gender segregated to encourage an open dialogue and also to be able to address gender-specific knowledge gaps. The two-day sessions covered reproductive health 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 daily 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.

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[8] *Girls who have had their menarche*

3 Methods

3.1 Study design
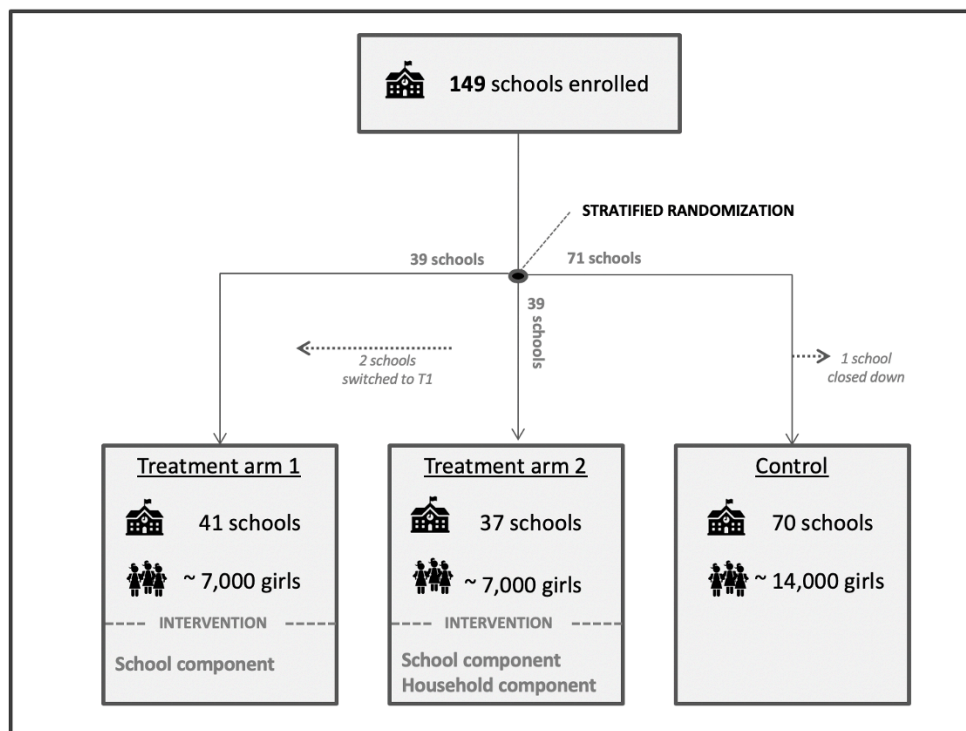
We conduct a cluster randomized impact evaluation of the *Ritu* program using a sample of 148 schools in a rural district in northern Bangladesh. All mixed-gender junior secondary schools in the district were eligible for the program. Junior secondary schools teach grades 6 until 8 and the average age 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 2 - 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.

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[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 menstrual health outcomes, such as MH practices, attitudes, and communication. Table 2 - 1 provides an overview of the main outcomes, the data sources used and the timing of data collection. Table A - 2 in the appendix shows a detailed overview of all outcomes and subdomains of outcomes. Most outcomes were 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

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

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

TABLE 2 - 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'. The entire enumeration team 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

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

and back-translated into English for cross-checking. Surveys were administered 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. Appendix 3 shows the full survey.

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. 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. We focus on aggregate monthly attendance rates per grade and gender, and individual attendance rates of our subset of surveyed girls.

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

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[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%).*

the potential of overcoming issues with misaligned incentives, self-reporting bias and 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 data collection process was designed to be as little disruptive as possible. The spot-checks were unannounced and happened approximately once a month.

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, 342 girls could not be tracked for the endline survey, mostly due to migration[14] 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 analysed the numbers and found that attrition does not appear to be systematically related to treatment status or observable co-variates (see Table A – 3 in the appendix for results). 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. Table 2 - 2 shows an overview of the analysis sample.

TABLE 2 - 2
Overview of analysis sample per treatment arm

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

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[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:

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

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 corrected p-values that adjust for multiple hypothesis testing. The parameters of interest are β_1 and β_2; the intention-to-treat effects.

We estimate 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 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. 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. 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 respective dependent variable.

4.1.1   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 - 3 shows the regression results. We find that MH test scores are significantly higher in both treatment groups (column 1). Next to an increase in menstrual knowledge, we also look at the availability of MH-friendly toilet facilities at school. Part of the *Ritu* program, is the construction of MH-friendly toilet facilities at schools by an NGO, and the maintenance of these facilities 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 - 3). 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 - 3), which is in line with expectations since both treatment arms received the exact same school program.

TABLE 2 - 3

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*** (0.142)	-7.552*** (2.781)	0.830*** (0.138)	0.661*** (0.118)	0.316** (0.133)	0.180* (0.092)	0.520*** (0.171)
T2: School + HH program	0.559*** (0.130)	-6.815** (2.862)	0.884*** (0.130)	0.663*** (0.118)	0.358*** (0.130)	0.145* (0.085)	0.334* (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. 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.*

4.1.2 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 significant barrier to safe MH and actively participating in society (e.g. attending school). Table 2 - 4 presents the descriptive statistics of girls' beliefs across treatment arms. For example, 8% of girls in the combined program believed a girl should avoid going outside when menstruating versus 18% in the control group. For our analysis, we run regressions on the index score of five activities (going outside, being around men, cooking, playing and eating 'white food[15]'), Table 2 - 5 shows the results. We find a significant and positive effect in both treatment arms. The regression coefficients suggest the program successfully lowered restrictive beliefs surrounding the mobility of girls on their menses.

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

TABLE 2 - 4

Descriptive statistics: girl's normative belief and expectations

	GIRL'S NORMATIVE BELIEFS		
	T1 % I agree	**T2** % I agree	**Control** % I agree
A menstruating girl should avoid:			
Going outside	10%	8%	18%
Being around men	21%	16%	30%
Cooking	8%	7%	15%
Playing	16%	17%	31%
Eating white food	13%	11%	36%

TABLE 2 - 5

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.

4.1.3 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. A supportive environment is a complex interplay of multiple factors, 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 2 - 6

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 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 2 - 7). 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 2 - 6). Moreover, girls in treated schools were more likely to get permission to go to the toilet when they asked their teacher (column 3, Table 2 - 7). 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 0% said their teacher provides it. In the school program, 51% provides it themselves, 38% by a family member and 11% by a teacher. In the combined program, family members are even more likely to provide the material with 47% providing the material (Table 2 - 6). 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 in both treatment arms.

TABLE 2 - 7

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: Teasing about MP ranges from 1 (never teased) to 4 (almost always); 'Boys understand' is a binary variable equaling 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). ^ '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 lives 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 also 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 own advantages and disadvantages and contain valuable information in different 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 data source.

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: $$absence\ rate_i = \frac{No.absent\ days_i}{No.open\ school\ days_j} \tag{2}$$

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

Spot $-$ check: $$absence\ rate_i = \frac{No.absent\ during\ spot\ check\ rounds_i}{No.total\ spot\ check\ rounds_j} \tag{4}$$

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 2 - 8. All three datasets show the same trend: school absence rates

are lower for girls in treatment arms than in the control group, and the difference is statistically significant (see p-values in Table 2 - 8).

TABLE 2 - 8
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 record 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. Absence rates in treatment schools are significantly lower than in control schools. Table 2 - 9 shows the regression results of the effect of the *Ritu* program on school attendance for all three data sources. Columns (1) and (2) present results for the school record data, with and without control variables. 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 regression results using 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 spot-check data (columns (5) and (6)), we find a treatment effect size of 8.8% (4.6ppts) for girls in the school program and 12.2% (6.4 ppts) in the combined program. All results are robust to the conservative Hochberg correction of multiple outcome testing. All three data sources show similar results; the *Ritu* program successfully reduced girl school absence significantly, and there is no significant difference between treatment effects in the school program versus the combined program. We thus do not find evidence that the combined program is more effective than the school program in reducing absence rates.

TABLE 2 - 9

School Records, Spot-check and Survey data of school absence 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 record 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 2 - 9 showed the *Ritu* treatment effect on girl school absence rates in general. We compared general absence rates across treatment groups, and show the menstrual health program reduces 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 similar results in this group of 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 (i.e., pre-menarche girls). We run the same regressions as in Table 2 - 4, and examine if the *Ritu* program has 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 - 4 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 improved Menstrual Health.

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 2 - 10). 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 2 - 10
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 program	-0.343***	-0.329***
	(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 male reproductive health were also covered, and the creation of a more open and supportive school environment. Moreover, boys 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 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 - 5 shows the results. Based on the school records, boys in the control group are absent 54% of the time. The school program significantly reduced boy absence rates with 10.1 ppts and the combined program reduced it with 12.5 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

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[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 a significantly positive effect of the menstrual health program on 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 school and we divide them into two categories (based on the data we have collected on them). First, the attrition sample; 342 girls dropped out of school and also could not be found for the endline survey. For these girls, our survey firm 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 drop out. For example, because 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

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[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 2 - 11 shows the results.

TABLE 2 - 11
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 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 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 levels of psychosocial wellbeing in general 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. Moreover, 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 and Sol, 2019). Therefore, we also examine confidence levels and prevalence of worries at school and at home. Table 2 - 12 shows the descriptive statistics of all psychosocial outcomes.

TABLE 2 - 12
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 2 - 13. 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

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[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 2 - 13

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 2 - 13, 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 2 - 13). 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 and at school. Therefore, we measured the subjective wellbeing during menses at home and at school. Table 2 - 14 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, Menstrual Hygiene Management (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 2 - 14
Subjective wellbeing during menses: at school and 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

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, mobility, or 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 2 - 15 shows 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 2 - 15
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

Table 2 - 16 shows the impact of the menstrual health interventions on our main outcome variable: the empowerment index (column 1) [20]. The school program did not have 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

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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 a 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.*

combined program thus seems to have had a small yet significant positive effect on increasing empowerment levels of girls.

TABLE 2 - 16
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 2 - 17

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 low- and middle-income countries, 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, find 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. As expected, the results 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 2 - 17 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 eating 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% of 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 2 - 18

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 2 - 18 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 and affordability 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 2 - 18). Table 2 - 19 (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 2 - 18). 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 2 - 18). We find no significant differences in treatment effects between school program and the combined program.

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. 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

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

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 2 - 19
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 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 2 - 18 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 2 - 20 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 2 - 20
Menstrual health – Open communication

	COMFORTABLE TALKING ABOUT MH	IN LAST 3 MONTHS, DISCUSSED MH WITH:		
		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:

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

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}). H_i is the respective heterogeneous variable, $T1_j$ and $T2_j$ are treatment dummies.

We find no strong evidence for differential treatment effects across subgroups (Appendix 11). 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 - 12 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 have higher treatment effects on school attendance during menses, and psychosocial wellbeing during menses. Regarding pre-program aspiration levels, we find mixed results (Table A - 13). 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, and for the cost-effectiveness analysis we will focus on its effect on education, one of the main aims of the program; reducing school absence rates of girls. Much of the CE literature in development focuses on education since education is a key objective of many policymakers and programs (Dhaliwal et al., 2013; Ganimian and Murnane, 2016; Garcia and Saavedra, 2017). Moreover, educational outcomes are easily quantifiable, can be compared across nations and most importantly, because female education is an importance indicator of (future) development and wellbeing. To ensure cost-effectiveness estimates in development are consistent across studies, we follow the methodology described by Dhaliwal et al. (2013) who laid out general guidelines for such analyses, and use 'years of schooling' and ' school attendance' as our outcome measures. 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 use 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 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 2 - 9 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] and whose benefits will likely accrue in the future once they have reached menarche. We calculate the cost-effectiveness ratio using the following formula:

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

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

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[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 record data, since this was the only method based on daily attendance and most suitable for the CE analysis.*

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

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);

$$Additional\ LAYS_{T_i} = Additional\ Years\ of\ Schooling_{T_i} * R_{BGD}^n \tag{7}$$

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_{BGD}^n) compared to other 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;

$$R_{BGD}^n = \frac{Average\ Learning\ per\ Year_{BGD}}{Highest\ possibel\ average\ Learning\ per\ Year} = \frac{368}{625} = 0.589 \tag{8}$$

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

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

Regarding the costs, we follow the guidelines of Dhaliwal et al. (2013) and use 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 2 - 21 shows the overview of program costs per treatment arm, and total number of beneficiaries. The

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[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*

total costs for implementers of treatment arm 1 was $419,921, and $714,527 for treatment arm 2.

TABLE 2 - 21
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

^girls in grade 6-8 during program implementation

6.2 Cost-effectiveness results

Table 2 - 22 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.

TABLE 2 - 22

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

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.

One of the most cost-effective programs to increase educational attainment in low- and middle-income countries 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

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[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).

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 CE 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 *learning-adjusted* years of schooling[28] for every $1000 spent (see Table A - 19 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

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[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.*

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.

7   Discussion

This study examines whether a multi-faceted menstrual health program leads to improvements in MH outcomes, education, empowerment and a range of psychosocial outcomes of adolescent girls 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 headmasters, 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 headmasters and school committees, which provided them with the freedom and confidence to teach MH modules in class. We also find that certain MH outcomes are dependent on the environment in which a girl manages 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

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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 her preferred material. 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 (T1) but the combined program (T2) 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. 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 male reproductive health, 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 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 because the estimates do not include long-term impact nor 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 an 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 analyse the exact channel through which the program affected boys and their barriers to education. Future studies could delve deeper into the 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

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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. All in all, this paper provides strong evidence that Menstrual Health interventions have the potential to improve development outcomes for adolescent girls in the short term (ie. increased school attendance) and bring about change in behavior and attitudes which most likely will positively affect future outcomes as well.

9 Appendix

A1. 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

A2. 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		√	√

A3. Survey

RITU Midline survey 2019 – Backtranslated version

Interview Start Time :						
Enumerator Reserve Codes: 99 = REFUSED; 98 = DON'T KNOW; 97 = Not Applicable						
A	Demographics					
A2	How old are you? (Completed years.)	Range (8 - 18)				
A2_1	Are you currently enrolled in school?	1. Yes 2. No				
A2_2	Have you switched schools in the last 2 years ?	1 Yes 2 No				
A3_up_name	Under which upazila is the school situated?					
A3	What is the name of your school ?					
A3_2	How long does it take to go from home to school by foot? (One way journey from house to school)	1= 5-10 minutes 2= 11-30 minutes 3= 31-60 minutes 4= > 60 minutes				
A3_3	If you need to walk to school alone, do you get permission from your family/guardian?	1= Yes 2= No 3= Sometimes				
A4	Which class in school are you in?					
A5_1	Have you moved villages in the last 2 years?	1 Yes 2 No				
A5	In which village do you live?					
A8_1	Since the last two years, are there any new members in your household?	1 Yes 2 No				
A8_1_1	If yes, how many ?					
A8_2	Household Roster					
	Can you tell me their age, gender and how you are related to them?	1=Biological father/mother, 2=Non-biological father/mother, 3=Grandfather/grandmother, 4=Brother/Sister, 5=Cousin,6=Niece/Nephew, 7=Aunt/uncle, 8=Servant, 9=Husband, 10=Father/Mother in law, 11= Husband's brother or sister, 12=Son/Daughter, 13 = Wife of elder brother, 96= Other				
Sl	Name1	Age1* (0-100) বয়স (0-100)	Sex1 (1=Male 2= Female)	Relation1 (1- 14)		
1						
A9_1	Since the last two years, did any one leave your household? "leaving could for example mean: passed away or migrated"	1 Yes 2 No				
A9_1_1	If yes, how many ?					
A9_2	Name2	Age2* (0-100)	Sex2 (1=Male, 2= Female)	Relation2 (1- 14)		
1						
B. Household Information						
B1	Taking all things together, how would you say things are these days, would you say you are?	1= Very unhappy 2= A little unhappy				

		3= Neutral 4= A little happy 5= Very happy
B2	How many of your household members are 12-years-old or younger? Including yourself	1= 3 or more 2= 2 3= 1 4= None [Skip to B4]
B3	Do all children in your household aged 6-to-12 currently go to school or an educational institution?	1= No 2= No one 6-to-12 3= Yes
B4	In the past year, did any household member ever do work for which he/she was paid on a daily basis?	1= Yes 2= No
B5	How many rooms does your house have? (excluding rooms used for business)	1= One 2= Two 3= Three or more
B6	Think about the walls of the main room, what main construction material is that made of?	1= Hemp/Hay/Bamboo, or other 2= Mud (unburnt) brick or CI (tin) Sheet/wood 3= Brick/cement
B7	Does your household own any televisions?	1= Yes 2= No
B8	How many fans does your household own?	1= None 2= One 3= Two or more
B9	Does anyone in your household own a mobile phone? If yes, how many phones in total?	1= None 2= One 3= Two or more
B10	Does your household own any bicycles, motorcycle/scooters, or motor cars etc.?	1= Yes 2= No
B12	Does your household have a private toilet? A private toilet is defined as a toilet where only the household has access to, and no outsiders	1 = Yes 2 = No
B13	When you're at home, do you use a toilet that is shared with other households?	1 = Yes 2 = No
B14	I will now ask you some things about the toilet, does the toilet have:	
B14_1	A functioning lock	1= Yes 2= No 3= Sometimes
B14_2	Soap	1= Yes 2= No 3= Sometimes
B14_3	A bin	1= Yes 2= No 3= Sometimes
B14_4	Water inside	1= Yes, most of the time running water 2= Yes, but most of the time not running water 3= No
B14_5	Water nearby	1 = Yes 2 = No 3 = Sometimes
B14_6	What is the source of the water? [allow for multiple answers]	1 = Tubewell 2 = Pond

		3 = Canal Other specify	
B14_7	Light	1= Yes, daylight 2 = Yes, electric light 3= No	
B14_9	Is the toilet clean?	1= Yes, always 2= Yes, often 3= Yes, sometimes 4= No rarely or never	
C.			
C3	Let's imagine for a second that you have the opportunity to study as far as you want, until what level would you like to study?	1=Class six 2=Class seven 3=Class eight 4=Class nine 5=SSC or equivalent 6= HSC or equivalent 7= BA passed 8=Honors 9= MA passed 10=Hafezi/religious education 11=forever other= Other specify	
C5	What is the main difficulty in achieving this?	1= Not smart enough 2= Lack of study habits or determination 3= Economic constraints (money, need to work) 4= Lack of family (HH) support 5= Lack of connections or acquaintances 6= Frequent illness (either yourself or a family member) 7= Time management (overwhelming) 8= Early marriage 9= Harrasment on the way to school 96= Other	
C6	Given your current situation, do you expect to reach that level of education?	1= Yes 2= No	
C7	For yourself, what is the reason you stopped coming to school?	1=Fail exam 2= Commute/distance 3= Cannot afford 4= Need to work 5= Marriage 6= Pregnancy 7= Not encouraged by guardian 8= No interest in school herself 9= Harrasment on the way to school other= Other specify	
C8	Would you say the decision to drop out of school was: mostly your decision, mostly your parents decisions, mostly the decision of some else namely…	1= mostly my decision 2= mostly my parents decision 3= mostly someone else's decision	
D			

D3	Imagine a ten step ladder like this one [enumerator show ladder], where on the bottom, the first step, stand children who have no choices or freedom to express their opinions and needs, and on the highest step, the tenth step, stand children with the most ability to express their opinions and freedom to choose what they want	
D3_1	On which step of the ladder are you today?	
D3_2	On which step of the ladder are most of your classmates/friends today?	
D3_3	On which step of the ladder will you be in five years time?	
D4	I will now ask you how often you feel a certain feeling. For each of the following feelings please show me how common the feeling is for you? [enumerator lay down the four answer category cards A in front of the girl]. We will use these cards to indicate your answers. Please point at the card that states your answer.	
D4_1	Embarrassment	1= Yes, almost always 2= Yes, often 3= Yes, occasionally 4= No, rarely or never
D4_3	Self-consciousness	1= Yes, almost always 2= Yes, often 3= Yes, occasionally 4= No, rarely or never
D4_4	Feeling humiliated	1= Yes, almost always 2= Yes, often 3= Yes, occasionally 4= No, rarely or never
D4_5	Feeling stupid	1= Yes, almost always 2= Yes, often 3= Yes, occasionally 4= No, rarely or never
D4_6	Feeling helpless	1= Yes, almost always 2= Yes, often 3= Yes, occasionally 4= No, rarely or never
D5	To what extent do you feel that people treat you with respect?	
D6	To what extent do you feel that people treat you unfairly?	
ME1	You were bothered by things that usually don't bother you	1= almost always 2= often 3= occasionally 4= rarely or never
ME2	You had trouble keeping your mind on what you were doing	1= almost always 2= often 3= occasionally

		4= rarely or never
ME3	Feeling depressed	1= almost always
		2= often
		3= occasionally
		4= rarely or never
ME4	Feeling that everything you did was an effort	1= almost always
		2= often
		3= occasionally
		4= rarely or never
ME5	Feeling hopeful about the future	1= almost always
		2= often
		3= occasionally
		4= rarely or never
ME6	Feeling fearful	1= almost always
		2= often
		3= occasionally
		4= rarely or never
ME7	Your sleep was restless	1= almost always
		2= often
		3= occasionally
		4= rarely or never
ME8	Feeling happy	1= almost always
		2= often
		3= occasionally
		4= rarely or never
ME9	Feeling lonely	1= almost always
		2= often
		3= occasionally
		4= rarely or never
ME10	Feeling like you could not get 'going'	1= almost always
		2= often
		3= occasionally
		4= rarely or never
D7	"I will now ask you how true the following statements are for you? For each of the following statements please show me how common it is for you?. We will use these cards to indicate your answers. Please point at the card that states your answer."	
D7_1	I feel free to decide for myself how to lead my life.	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true
D7_2	I generally feel free to express my ideas and opinions at home	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true

D7_3	I generally feel free to express my ideas and opinions amongst friends	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D7_4	I generally feel free to speak up in class or raise my hand	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D7_5	I easily connect with new people	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D7_6	I consider myself close to the people I regularly interact with.	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D8	To what extent do you agree with the following statements?		
D8_1	A girl should not expect to inherit her father's property.	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D8_2	It's more important for boys to get an education than it is for girls	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D8_3	Girls should have just the same chance to work outside the home as boys	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D8_4	Boys should have more free time than girls.	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D8_5	At home boys should always eat first.	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D8_6	The higher the earnings of the boy the more he deserves to get dowry	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D8_7	A girl who disagrees with her brother in public is impolite	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	

D8_8	Girls should be sent to school only if they are not needed to help at home.	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D8_9	Giving dowry to a girl is more important than investing in her education.	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D8_10	It is better to be a man than to be woman	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	
D8_11	Girls should be allowed to wear whatever they want without being harassed	1= Not at all true 2= Somewhat true 3= Mostly true 4= Completely true	

Note 4:			
D9	In the last month , how often did you go to or visit the following places		

	Place	Frequency (0-100) if answer is 0 skip to next place	Did you go there alone? (1= Yes 2= No 3= Sometimes)	If you need to go there alone, do you get permission from your family/guardian? (1= Yes 2= No 3= Sometimes)
		D9_a	D9_b	D9_d
1	Market			
2	Relatives outside your village			
3	Friends in your village			
4	A religious place (eg. shrine, church, mosque, temple)			

E: Menstruation and reproductive health – knowledge

Note 5:		
E1	Who first told you about Menstrual Periods?	1= Male Teacher 2= Female Teacher 3= Mother 4= Father 5= Grandfather 6= Grandmother 7= Sister 8= Wife of brother 9= Brother 10= Friends 11= TV 12= Radio/other media 13= No one, I don't know what it is 14= schoolbook 96= Other
E2	Why do some girls miss school when they have their Menstrual Periods?	1= Cramps/bad physical feelings 2= Fear of leaking 3= Don't have menstrual material 4= Not allowed to leave the house/go to school 5= No sanitary facilities at school 6= No support/understanding at school 7= Teacher told me to go home

		8= It is normal not to go to school during menstruation other= Other specify
ET1	From one period to the next, are there certain days when girls/women are more likely to become pregnant?	1= Yes 2= No
ET2	When is a girl/woman more likely to become pregnant; just before her period begins, during her period, right after her period has ended, or halfway between two periods?	1= Just before MP 2= During MP 3= Right after MP 4= Halfway between 2 MP 5= none of the above

Note 6:		
ET3	Sadia: Taller girls start menstruating earlier Mim: Menstruation can start at 11 but also at age 15	1 = Sadia is correct 2 = Mim is correct
ET4	Sadia: Menstruation happens every month on the same date. Mim: Menstruation happens every 25 to 35 days, depending on the woman	1 = Sadia is correct 2 = Mim is correct
ET5	Sadia: If a menstruating girl cooks, the food gets contaminated by her touch Mim: If a menstruating girl cooks, the food is not affected by her touch	1 = Sadia is correct 2 = Mim is correct
ET6	Sadia: Pain in the lower stomach during menstruation is dangerous Mim: Pain in the lower stomach during menstruation is normal	1 = Sadia is correct 2 = Mim is correct
ET7	Sadia: When I wash my reusable cloth, using cold water is better to get the stains out Mim: When I wash my reusable cloth, using hot water is better to get the stains out	1 = Sadia is correct 2 = Mim is correct
ET8	Sadia: If a girl steps over the robe of a cow, it does not affect her menstrual bleeding Mim: If a girl steps over the robe of a cow, her menstrual bleeding will be heavier	1 = Sadia is correct 2 = Mim is correct
ET9	Sadia: Drying cloth in the sunlight kills bacteria and is therefore more hygienic Mim: Drying cloth in the shade kills bacteria and is therefore more hygienic	1 = Sadia is correct 2 = Mim is correct
ET10	Sadia: Menstrual blood comes from the uterus Mim: Menstrual blood comes from the stomach	1 = Sadia is correct 2 = Mim is correct
ET11	Sadia: if a menstruating girl sits in a place a boy previously sat, she can get pregnant Mim: A girl cannot get pregnant during her menstruating days	1 = Sadia is correct 2 = Mim is correct

F: Menstruation and reproductive health - practices		
Note 7:		
F1	Have you started your MP?	1= Yes 2= No
F2_1	How old were you when you first started your MP?	………..Year
F3	When you had your first MP, did you know what it was?	1= Yes 2= No
F4_1	What are all the materials that you use for your period in general? [allow for multiple answers]	1= cloth / towel 2= toilet paper 3= only underwear 4= disposable sanitary pad 5= cotton other= Other specify

F5	Which material do you use most often to catch your MP at home?	1= cloth / towel
		2= toilet paper
		3= only underwear
		4= disposable sanitary pad
		5= cotton
		other= Other specify
F5_1	Who usually provides you with the material you use to catch your MP at home?	1= Obtain it myself
		2= Mother
		3= Father
		4= Sister/Sister in law
		5= Other family member
		6= Male teacher
		7= Female teacher
		8= Friends
		10= Available in toilet facility
		other= Other specify
F8	Where do you or where does this person usually get the material you use to catch your MP?	1= Local shop
		2 = School
		3= From non-profit organisation/NGO
		4= From Government organisation/health worker
		5 = Pharmacy
		6= Used cloths/fabrics
		other= Other specify
F6	Which material do you use most often to catch your MP at school?	1= cloth / towel
		2= toilet paper
		3= only underwear
		4= disposable sanitary pad
		5= cotton
		other= Other specify
F7	Who usually provides you with the material you use to catch your MP at school?	1= Obtain it myself
		2=Mother
		3= Father
		4=Sister/Sister in law
		5=Other family member
		6=Male teacher
		7=Female teacher
		8= Friends
		10= available in toilet facility
		other= Other specify
F9_1	On the heaviest day of your period, how frequently in one day do you change your menstrual material	1= 1 time a day
		2= 2 times a day
		3= 3 times a day
		4= 4 times a day
		5= Over 5 times a day
		6= Never change material

F9_2	When you have your period, do you ever change your [F6_name] when you are at school?	1= Yes 2= No		
F9_3	Where did you most often change your menstrual materials when you were at school?	1= school latrine 2= outside 3= in another room at school 96 = Other		
F11	Where did you dispose of your used menstrual materials at school?	1= Latrine 2= Throw in bush 3= Keep it to wash and reuse 4= Dispose at home 5= Community rubbish heap 6= Bury 7= Throw in nearest bin 8= Burned other= Other specify		
F12	Where did you dispose of your used menstrual materials at home?	1= Latrine 2= Throw in bush 3= Keep it to wash and reuse 4= Dispose at home 5= Community rubbish heap 6= Bury 7= Throw in nearest bin 8= Burned other= Other specify		
Note 8:				
F15	How often did you wash the material you used to catch your MP on average?	1= One time during my whole MP 2= Less than once a day 3= once a day 4= Twice a day 5= More than two times a day		
F16	During your last period, how often did you use soap to wash your materials?	1= Every time I use soap 2= Sometimes I use soap 3= I never use soap		
F18	When washing the material used to catch your MP, what was the temperature of the water you used?	1= Hot water 2= Cold water 3= Both, used hot and cold water		
F20	Where did you dry the material?	1= outside in the sun 2= outside but not in the sun 3= in my room or another private place inside 4= under my bed, in a drawer or another hidden place. 5= under another piece of cloth other= Other specify		
F21	During your last period, how often were your materials completely dry before you used them?	1= Never 2= Sometimes 3= Every time		
F24	In the last 2 years, did you experience any of the following during your MP?	F24_1	Skin irritations in the pubic area	1= Yes 2= No
		F24_2	Rashes in the pubic area	1= Yes

				2= No
		F24_12	headache	1= Yes 2= No
F24a	If you experience cramps during your MP, on a scale from 1 to 10 how severe do you feel they are?			
Note 9:				
F26_1	At home, how often do you worry about odor during your MP?			1= Almost always 2= often 3= sometimes 4= rarely or never
F26_2	At school, how often do you worry about odor during your MP?			1= Almost always 2= often 3= sometimes 4= rarely or never
F27	During your MP, how often do you feel embarrassed?			1= Almost always 2= often 3= sometimes 4= rarely or never
F28	How often do the boys you know tease girls about their MP?			1= Almost always 2= often 3= sometimes 4= rarely or never
F29	How often are you teased about your MP?			1= Almost always 2= often 3= sometimes 4= rarely or never
F30	During your MP, how often do you feel more insecure than usual?			1= Almost always 2= often 3= sometimes 4= rarely or never
Note1				
F31_1	How confident do you feel to manage your MP at home? Manage describes collecting, washing, drying and changing materials you use to catch your MP			1= Very confident 2= A little confident 3= Neutral 4= A little unconfident 5= Very unconfident
F31_2	How confident do you feel to manage your MP at school? Manage describes collecting, washing, drying and changing materials you use to catch your MP			1= Very confident 2= A little confident 3= Neutral 4= A little unconfident 5= Very unconfident
note				
P1	I was able to choose the menstrual material I wanted to use			1= Almost always 2= often 3= sometimes 4= rarely or never
P2	I worried that my menstrual blood would soak through my menstrual material to my outer garments			1-4
P3	I worried that my menstrual materials would move out of place			1-4
P4	I had enough of my menstrual materials to change them as often as I wanted to			1-4

P5	I felt comfortable transporting used materials to wash or dispose of them	1-4
P7	I was able to wash my hands when I wanted to	1-4
P8	I was able to wash my genitals when I wanted to	1-4
P9	I felt clean	1-4
P10	I was able to dispose of my used materials in the way that I wanted to	1-4
	At home and at school	
P11	When at home, I worried that I would not be able to change my menstrual materials when I needed to	1-4
P12	When at home, I worried that someone would see me while I was changing my menstrual materials	1-4
P13	When at home, I worried that someone would harm me while I was changing my menstrual materials	1-4
P14	When at school, I worried that I would not be able to change my menstrual materials when I needed to	1-4
P15	When at school, I worried that someone would see me while I was changing my menstrual materials	1-4
P16	When at school, I worried that someone would harm me while I was changing my menstrual materials	1-4
P17	I had enough soap and water to soak and wash my menstrual materials between uses, during my last period	1-4
P18	I was worried that someone would see me while I was washing my menstrual materials	1-4
P19	I worried that my menstrual materials would not be dry when I needed them	1-4
P24_1_1	I worried that other would see my menstrual materials while they were drying	1-4
G	School Attendance and performance	
G1	When you think about a typical month of school, how many days of school do you miss on average?	
G2_1	How often do you miss school due to:	
G2_1_1	Being on your MP	1= Almost always 2= often 3= sometimes 4= rarely or never
G2_1_2	Illness (other than having MP)	1= Almost always 2= often 3= sometimes 4= rarely or never
G2_1_3	Household work (agriculture/caring for family members)	1= Almost always 2= often 3= sometimes 4= rarely or never
G2_1_4	Bad weather (incl. floods and heavy rain)	1= Almost always 2= often 3= sometimes 4= rarely or never

G3	Did you miss any days of school last time you menstruated when school was in session?	1= Yes 2= No		
G4	How many days of school did you miss last time you menstruated when school was in session?			
G5	When you missed school due to MP, what were the reasons?	1= Cramps/bad physical feelings 2= Fear of leaking 3= Don't have menstrual material 4= Not allowed to leave the house/go to school 5= No sanitary facilities at school 6= No support/understanding at school 7= Teacher told me to go home 8= It is normal not to go to school during menstruation other= Other specify		
Note-g:				
G6	What activities or situations do you rather avoid while you are on your MP?			
G6_1	Serving food and beverages to guests	1= Yes 2= No		
G6_3	Going outside	1= Yes 2= No		
G6_4	Being around men/boys	1= Yes 2= No		
G6_5	fetching water	1= Yes 2= No		
G6_6	cooking	1= Yes 2= No		
G6_7	being in a religious space	1= Yes 2= No		
G6_8	physical sports/exercise	1= Yes 2= No		
G6_9	religious activities (praying, touch religious books)	1= Yes 2= No		
G6_10	playing with other children	1= Yes 2= No		
G6_11	working in the field/garden	1= Yes 2= No		
G6_12	going to school	1= Yes 2= No		
G6_13	doing homework	1= Yes 2= No		
G6_14	sitting in a place where a men/boy just sat	1= Yes 2= No		
G6_15	bathing in pond	1= Yes 2= No		
G7	eating white foods (banana, egg, milk)	1= Yes 2= No		
G8	eating proteins (meat, fish)	1= Yes 2= No		
G11	Looking in the mirror	1= Yes 2= No		
G12	Different people may have different ideas on the types of activities girls are allowed to do when they have their period. I will read out a few statements and per statement if you agree or disagree. And I will ask what you believe your parents and grandparents think. Please remember that there are no right or wrong answer her, I just want to learn your opinion.	I, myself:	My parents (or guardians):	My grandparents (or other elderly in my family):
		G12_1	G12_2	G12_3

1	A girl should avoid going outside whilst on MP	1= agree 2= disagree	1= agree 2= disagree	1= agree 2= disagree
2	A girl should avoid being around men/boys whilst on MP	1= agree 2= disagree	1= agree 2= disagree	1= agree 2= disagree
3	A girl should not cook whilst on MP	1= agree 2= disagree	1= agree 2= disagree	1= agree 2= disagree
4	A girl should not play with other children whilst on MP	1= agree 2= disagree	1= agree 2= disagree	1= agree 2= disagree
5	A girl should not go to school whilst on MP	1= agree 2= disagree	1= agree 2= disagree	1= agree 2= disagree
6	A girl should not eat white foods whilst on MP	1= agree 2= disagree	1= agree 2= disagree	1= agree 2= disagree
H				
H1	Do you feel comfortable talking about MP in general?	1= Yes 2= No		
Note12. In the last 3 months				
H2	In last 3 months, Talk with your parent/guardian about topics related to Menstrual Period	1= Yes 2= No		
H2_1	Which topic(s) did you most often discuss?	1 = Support with physical tasks (eg. Menstrual materials and management) 2 = Support with mental issues (feeling sad, unconfident etc. 3 = Physical wellbeing (eg. Feeling physical pain) 4 = restrictions during MP other= Other specify		
H21_1	Talk with your grandparents/elderly family members about topics related to Menstrual Period	1= Yes 2= No		
H21_2	Which topic(s) did you most often discuss?	1 = Support with physical tasks (eg. Menstrual materials and management) 2 = Support with mental issues (feeling sad, unconfident etc. 3 = Physical wellbeing (eg. Feeling physical pain) 4 = restrictions during MP other= Other specify		
H3	In last 3 months, Did you talk with your sibling(s) about topics related to Menstrual Period	1= Yes 2= No		
H3_1	Which topic(s) did you most often discuss? (let them answer freely, enumerator fill in the code yourself – allow for multiple answers)	1 = Support with physical tasks (eg. Menstrual materials and management) 2 = Support with mental issues (feeling sad, unconfident etc. 3 = Physical wellbeing (eg. Feeling physical pain) 4 = restrictions during MP other= Other specify		
H4	In last 3 months, did you talk with your friends about topics related to Menstrual Period	1= Yes 2= No		

H4_1	Which topic(s) did you most often discuss?	1 = Support with physical tasks (eg. Menstrual materials and management)
		2 = Support with mental issues (feeling sad, unconfident etc)
		3 = Physical wellbeing (eg. Feeling physical pain)
		4 = restrictions during MP
		other= Other specify
H5	In last 3 months, did you talk with your teacher about topics related to Menstrual Period	1= Yes
		2= No
H5_1	Which topic(s) did you most often discuss?	1 = Support with physical tasks (eg. Menstrual materials and management)
		2 = Support with mental issues (feeling sad, unconfident etc.
		3 = Physical wellbeing (eg. Feeling physical pain)
		4 = restrictions during MP
		other= Other specify
I		
Note 13.		
I1	Do you like going to school?	1= Dislike very much
		2= Dislike a little
		3= Neutral
		4= Like a little
		5= Like very much
I2	How many functioning toilets are there at your school that you can use?	
I4_21	Do you get permission from teachers to go to the toilet when you ask?	1= Yes, always
		2= Yes, sometimes
		3= Yes, occasionally
		4= No, not at all
I10	Do you feel that the boys in your class understand what MHM is?	1= Yes
		2= No
I11	Does the toilet that you use at school have:	
I11_1	A functioning lock	1= Yes
		2= No
		3= Sometimes
I11_2	Soap	1= Yes
		2= No
		3= Sometimes
I11_3	A bin	1= Yes
		2= No
		3= Sometimes
I11_4	Water inside	1= Yes, most of the time running water [
		2= Yes, but most of the time not running water
		3= No
I11_5	Water nearby	1 = Yes
		2 = No
		3= Sometimes

I11_6	What is the source of the water? [Allow multiple answer]	1 = Tubewell 2 = Pond 3 = Canals other= Other specify
I11_7	Light	1= Yes, daylight 2 = Yes, electric light 3= No
I11_8	How often is the toilet clean?	1= always 2= often 3= sometimes 4= rarely or never
I11_9	Is the toilet girls-only?	1= Yes 2= No
J	Reproductive and sexual behaviour & marriage	
Note 13.		
J1	Are you married?	1 = Yes [Skip to J4] 2 = No
J3	Are there plans for you to be married within the next year?	1 = Yes 2 = No [SKIP to J8]
J4	Have you ever been sexually active?	1= Yes 2 = No [SKIP to J8]
J5	Have you ever been pregnant?	1= Yes 2 = No [SKIP to J8]
J6	Are you currently pregnant?	1= Yes 2= No
J8	What do you think is the latest age a girl should get married?	1= [years] 2= any age
J8_yr	Latest age a girl should get married	
J8_1	Would you like to marry in future?	1= Yes 2= No
J9	At what age would you like to get married?	
J10	Do you think that you will be allowed to say no to a marriage proposal?	1= Yes 2= No
J11	Have you ever tried to negotiate with your parents about getting married?	1= Yes 2= No
J12	Do you think you will be allowed to continue your education after you get married?	1= Yes 2= No
J13	In the future, would you like to have any children?	1= Yes 2= No
J14	Of those children, how many girls would you like to have?	
J15	Of those children, how many boys would you like to have?	

Closing Note:

A4. Attrition analysis

Not all participants of the baseline study could be found at time of endline, mostly due to having migrated out of the study area. As such, we have an attrition rate of 9%, or 342 girls. The tables below show that there were no systematic differences related to treatment status or a subset of observable co-variates, between the analysed sample and the attrition sample.

NUMBER OF ATTRITION GIRLS PER TREATMENT GROUP

	TREATMENT 1	TREATMENT 2	CONTROL GROUP	TOTAL
Attrition	95 girls	114 girls	133 girls	342 girls

TABLE A - 3
DESCRIPTIVE STATISTICS OF TREATMENT STATUS AND OBSERVABLE COVARIATES OF

ATTRITION VS ANALYZED SAMPLE

VARIABLE	ATTRITION SAMPLE MEAN	ANALYSIS SAMPLE MEAN	P-VALUE TWO-SAMPLE T-TEST
Treatment status	2.17	2.11	0.206
Preprogram menarche	1.60	1.61	0.516
# Female role models in HH	1.57	1.56	0.859
Household size	5.14	5.10	0.640
Educational aspiration	3.00	3.10	0.041*
Distance home to school	1.85	1.85	0.906
School toilet: soap available	2.51	2.60	0.089
HH toilet: soap available	2.64	2.70	0.248
No. observations	342	2127	

* Statistically significant, but economically insignificant value

A5. Education: treatment effects on school absence rates of pre-menarche girls

TABLE A - 4

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 record 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.

A6. Education: boy school absence rates

TABLE A - 5

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	-0.125***
	(0.032)
Control Mean	0.541
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 record 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.

A7. Psychosocial outcomes general and during MP – without control variables

TABLE A - 6

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 (0.291)	-0.060 (0.059)	0.130* (0.069)	-0.020 (0.083)
T2: School + HH program	0.381 (0.277)	0.050 (0.050)	0.226*** (0.061)	0.178*** (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)

A8. Subjective wellbeing during MP – without control variables

TABLE A - 7

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*** (0.095)	0.777*** (0.194)	0.132** (0.055)	0.104 (0.073)	0.075 (0.141)	0.055 (0.054)
T2: School + HH program	0.517*** (0.094)	0.523** (0.218)	0.147*** (0.053)	0.173** (0.080)	0.028 (0.119)	0.073 (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).

A9. 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 - 8
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.

A10. General Empowerment Subindex: gender attitudes

TABLE A - 9

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)

A11. General Empowerment Subindex: opinions and decisions

TABLE A - 10

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)

A12. General Empowerment Subindex: aspiration

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 - 11

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.

A13. 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 - 12
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

| | 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 - 14).

TABLE A - 14
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 - 15
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

<div align="center">

TABLE A - 16

Heterogeneity: grandparents within household

</div>

	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 - 17
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 - 18
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.

A.14 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 - 19

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

Chapter 3

Meet the parents: impact of a menstrual health intervention on parental implicit and explicit attitudes towards menstrual taboos in rural Bangladesh

This chapter is co-authored by

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1 Introduction

Strong norms and beliefs about menstruation and negative attitudes towards menstruating persons, are a widespread and pervasive problem in many low- and middle-income countries (Alam et al., 2017; Chandra-Mouli and Patel, 2017; Lundgren et al., 2013; Oster and Thornton, 2011). Ethnographic work in several African and Asian countries has demonstrated that menstruation is often associated with pollution and seclusion – menstrual blood is believed to adversely affect men's luck and contaminate items and individuals the woman comes in contact with. Consequently, women and girls are prevented from freely moving in their community and are sometimes isolated in shelters during their menses (Agyekum, 2002; Buckley and Gottlieb, 1988). Apart from reducing a woman's social status and agency, such norms and beliefs also facilitate poor menstrual health and impose severe costs in terms of human capital development: the on-set of menstruation often implies additional restrictions for girls and is believed to be associated with higher levels of school absence during their period and school dropout (Sommer, 2011). Despite its clear relevance, studies on the impacts of menstrual taboos were until recently, largely based on qualitative research methods with little attention for possibly effective interventions that can mitigate adverse effects (Sommer and Sahin, 2013). More recent studies have tackled this issue to some extent, and target breaking down menstrual health barriers through education, alleviating supply side constraints by e.g., building safe women-friendly toilet facilities and providing menstrual products at low or no costs (Haque et al., 2014; Montgomery et al., 2016; Oster and Thornton, 2011; Phillips-Howard et al., 2016). Yet few of them use rigorous methods to evaluate the effectiveness of such interventions and many arrive at mixed results.

In a companion paper (Sol et al., 2021) we are the first to provide rigorous evidence of a positive impact of a randomized menstrual health intervention – the *Ritu* program - on school attendance and psychosocial outcomes among a sample of adolescent girls in the Netrakona district of Bangladesh. In Bangladesh, more than 40% of girls say they on average miss three days of school each month when they are on their period (Alam et al., 2017) thereby compromising girl's wellbeing, education and socio-

economic outcomes, now and throughout their life. The *Ritu* program aims to mitigate barriers to menstrual health (MH) to help improve outcomes for girls and women by offering a comprehensive and multi-faceted program to schools and households.

The program is an NGO-led randomized intervention with two treatment arms and a single control group. Randomization took place at the school level. Treatment arm I is a school-based program comprising: (i) facilitating the construction and maintenance of MH-friendly toilet facilities at school, ii) incorporating reproductive health- and MH-modules into the school curriculum through teachers and (iii) stimulating a supportive MH-environment through various extra-curricular events including student discussion groups, documentaries etc. Treatment arm II schools also receive the targeted household program in addition to the school program. Parents (or guardians) of the adolescent girls received two sessions to increase MH knowledge and emphasize the important roles they can play in providing their menstruating daughters with tools and support they need to practice safe MH and partake in daily activities. The *Ritu* program kicked off with a launching campaign to familiarize students and staff with the *Ritu* program through discussions, essay-writing, and a screening of a MH reality TV show. All these components together are expected to address the main menstrual barriers adolescent girls are facing in our study setting; lack of facilities and tools, lack of knowledge and lack of support.

We use the design and outcomes of the Sol et al., (2021) paper as basis for the present study where we investigate in more detail whether *Ritu* also affects parental attitudes towards menstruation and menstrual health management, that may reflect one possible channel (among others) for improved schooling and psychosocial outcomes. While preferences and strong negative norms towards menstruation are deeply rooted in Bangladeshi culture, the fact that we observe a behavioral change in Sol et al., (2021) in response to a targeted intervention leads us to hypothesize that (certain) menstrual taboos may be amenable to change. Indeed, some taboos for example related to religious practice, may be more persistent than others and malleability may also co-vary with parents' personal traits including age and gender. A number of studies establish positive correlations between educational interventions on

menstrual health and changes in knowledge, attitudes and self-reported behavior, including school attendance. Yet, these studies primarily use non-randomized designs which complicates a causal interpretation of their findings. Moreover, they only have limited and crude proxies of attitudes or beliefs towards menstruation (see Sumpter and Torondel, 2013 for a systematic review). Other, more rigorous evaluations find limited evidence of behavioral change and do not report on attitudes or beliefs (Montgomery et al., 2016; Oster and Thornton, 2011; Phillips-Howard et al., 2016).

Measuring attitudes and beliefs is difficult, especially vis-à-vis sensitive topics like menstruation. The most common approach using self-reported answers to survey questions or statements is well-known for its proneness to social desirability issues, experimenter demand effects and high item non-response rates (de Quidt et al., 2019; Tourangeau and Yan, 2007; Turner et al., 1998). In response, other less obtrusive methods like the popular implicit association test (IAT) have been developed and are believed to measure unconscious 'deep' preferences that are stable over time and do not respond to interventions even if conscious (explicit) measures do (Bargh and Chartrand, 1999; Wilson et al., 2000). Yet more recent studies suggest also some implicit attitudes are malleable in response to (lab) interventions (Gawronski and Bodenhausen, 2006; Lai et al., 2013) although such effects may fade out quickly with implicit attitudes returning to preintervention levels once the intervention ends (Lai et al., 2016). Also, IAT tests have sometimes been criticized for having low test reliability and validity (Blanton et al., 2009; Mitchell and Tetlock, 2015) or confounding factors like cognitive skill (McFarland and Crouch, 2002) but a meta-analysis by Greenwald et al., (2009) shows that predictive validity of an IAT is high when measuring attitudes towards sensitive topics with participants that are unfamiliar with such measurements.

Given the shortcomings of both implicit and explicit measures, we believe a combination of these methods can provide insights into attitudinal changes in response to an intervention like ours. Moreover, key advancements in understanding IAT results, their duration, links with explicit attitudes and underlying mechanisms, have all been in the field of racial and gender stereotypes in developed economies

(Neto et al., 2015; Rudman and Kilianski, 2000; Shook and Fazio, 2008). Findings may be different for IATs administered in low- and middle-income countries than in developed countries.

We therefore develop and test a novel application of the IAT to assess individual parental attitudes towards menstruation in addition to eliciting explicit attitudes through standard survey responses. Specifically, we test (i) whether the *Ritu* program affects parental implicit and explicit attitudes of menstruating girls; (ii) whether some menstrual taboos are more amenable to change than others; and (iii) if malleability co-varies with parental characteristics like gender and age.

Our design is related to two other studies that have measured implicit attitudes in response to a large-scale randomized development intervention. Beaman et al. (2009) investigate whether exposure to female village leaders through reserved council seats affects perceptions of effectiveness and preferences for female leadership in West-Bengal, India. They find that while exposure does not change preferences, it does affect perceptions of effectiveness and ultimately voting decisions in favor of women leaders. Vogt et al. (2017) use entertaining movies depicting local, within-family divergent views about genital cutting for girls in Sudan and find large effects on improved implicit attitudes towards uncut girls.

This paper contributes to the small evidence base on how targeted menstrual health interventions causally affect changes in attitudes where we explore different ways of measuring these attitudes. Moreover, we conjecture that attitudes towards certain actions or behavior may be more resistant to change - for example attitudes towards participating in religious activities - and that deep preferences and strong social norms as captured by our implicit measures may not change at all – at least not in the short run.

All of our attitudinal measurements were administered to a sample of parents after the completion of the intervention targeted at the households. "Attitudes towards menstruation" may be a too abstract concept for people to relate to, we take a pragmatic approach and measure attitudes towards six daily activities that are considered taboo for a girl to engage in during her menstruation. These taboos include

cooking, playing with friends, going to school, eating white foods (such as banana, milk and egg), washing clothes and praying. Our implicit measure captures attitudes towards the entire 'set' of taboos, whereas with our explicit measure we can also study attitudinal changes towards certain taboos separately, which allows us to examine whether certain taboos may be more amenable to change than others.

We find the *Ritu* program has a strong effect on changing self-reported explicit attitudes among parents: parents in the treatment group are more likely to agree that menstruating girls should be able to cook, play with friends, eat white foods and wash clothes. We also find they are more likely to report their own daughter(s) are allowed to undertake these activities during their period - i.e., treatment parents are less likely to impose restrictions on their daughters. We also find that both measures correlate but that the strength of this correlation differs per taboo - varying from only 0.29 for praying to 0.76 for eating white foods or washing in the river while on menses. This may suggest that other factors than attitudes alone drive parental decision making.

Implicit attitudes as measured by our IAT are unaffected by the *Ritu* program. Sensitivity checks, where we trim our sample by excluding the slowest 10% and participants that made too many initial errors, show results that point in the same direction as our outcomes for our explicit measures and self-reported restrictive behavior, but results remain non-significant. Even while implicit attitudes stay unchanged, conscious (explicit) beliefs about the ability and effectiveness of supporting girls during their menstruation and sending girls to school (among other things) clearly adapt in response to the *Ritu* intervention. This can at least partially explain the observed improvements in outcomes related to school attendance and psychosocial wellbeing as reported in Sol et al., (2021).

Disaggregation results on explicit measures lend credence to the hypothesis that an intervention like *Ritu* is able to change attitudes towards some, but not all menstrual taboos. Preferences and deeply engrained social norms as measured by our implicit attitudes are not affected in the short run, nor do they apparently have to, in order to bring about desirable behavioral change as measured through our improved school attendance measures. Our findings extend the evidence base on implicit and explicit

attitudes change in relation to randomized policy interventions that aim to improve development outcomes for women and adolescent girls.

The rest of the paper is organized as follows. In section 2 we discuss the study context and lay out the design of the IAT as well as our measures for explicit attitudes. Section 3 presents the results. In section 4 we provide possible interpretations for our findings and section 5 concludes.

2   Study context and empirical design

The *Ritu* program is an initiative led by Simavi, a non-governmental organization. The program aims to change beliefs, attitudes and behavior towards menstrual health, through facilitating improved facilities at schools and provide training to adolescent girls, their peers and their parents[1]. Implementation of *Ritu* started in 2017 and the program targets 15,000 adolescent girls in 78 schools and 15,000 parents in Netrakona[2] district in rural Bangladesh.

For the purpose of this paper, we are interested in parental attitudes and beliefs regarding menstruation and therefore focus solely on Treatment II participants in comparison to the control group. This means that for this paper we leave out schools that were randomized into Treatment I. Recall that Treatment II is the combined school and household -level intervention, hence we are only able to test the joint effect of these treatments on parental attitudes and self-reported imposed restrictions towards their daughter(s), thereby comparing outcomes for households exposed to Treatment II versus the control group. We have little reason to believe that the household component alone would have any impact – indeed the implementing partners designed the intervention in accordance with their Theory of Change such that households would never only receive the household intervention. We expect that the combined direct (though parental training) and indirect (through their daughters'

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[1] *The study protocol by Sol et al. (2019) provides more detail on the randomized design and intervention.*

[2] *We study the effect of the Ritu program on adolescents in Netrakona district. A small part of the Ritu program was outside the scope of our study, and targeted girls outside the Netrakona district. The overall target of the Ritu program is thus bigger than what we report for the targets in our study area. See Appendix 4- Study Area, for a map of the study area.*

school program)[3] effect may be strong enough to lead to measurable changes in parental attitudes. Below we describe the sampling strategy and the data collection methods we used for the purpose of this paper.

2.1 Sample size

We conduct power calculations to estimate the required sample size of parents whose daughters are exposed to the *Ritu* program. We expect the IAT to generate smaller effects than our measure for explicit attitudes hence we base power on the desired minimum detectable effect size for our IAT measure. This implies that the number of parents invited to take part in the IAT determines the overall sample size for our study.

This is the first study to elicit attitudes towards menstruation through an IAT. Since the majority of IAT studies is conducted in lab settings and in high-income countries, we have little guidance as to what to expect in a field test like ours. We therefore turn to the handful of field studies in development that have used an IAT to measure impacts on implicit attitudes in response to a (randomized) field intervention. We consider the research by Vogt et al. (2017) to be closest to our IAT set-up and use their results on attitudes towards genital cutting – similar to menstruation, a highly sensitive health-related topic subject to strong gender norms and preferences - to calculate a minimum detectable effect size of what we expect to find for attitudes towards menstrual health. We expect a minimum detectable treatment effect of a 0.15 difference in D-score, with a standard deviation of 0.49, alpha of 0.05 and power of 90% significance (Beaman et al., 2009; Vogt et al., 2017). This results in a required sample size of 500 participants. We drew a stratified randomized sample with stratification based on three sub-districts and *Ritu* treatment status. The baseline data from the Sol et al., 2021 paper serves as our sampling frame from which we randomly select the girls' households from Treatment arm II and the control group respectively. We selected 250 respondents from Treatment arm II villages and 250 from control villages[4]. We implemented the experiment and survey with 500 parents that have

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[3] *Impacts of the school program affecting parental attitudes may come through multiple sources, including foremost their own daughters but also through for example talks with other parents, school or community level events etc.*

[4] *In these control villages there was no child going to a treatment school.*

daughters between 13-15 years of age. We stratified our sample of parents on the basis of gender of the parental respondent. We trained 10 enumerators on how to conduct the IAT with respondents and used an iterative process to pre-test and further refine the IAT on the basis of test results and feedback. Enumerators would visit people in their house and were carefully instructed on explaining the purpose and execution of the IAT to the respondents. All of our selected parents belonged to separate households, that is, we did not include any spouses. We obtained informed consent from all our participants, by reading out the consent form and asking for a signature or fingerprint. Additionally, all participants received instructions about their voluntary participation. Below, we first describe our self-reported survey measures before explaining the IAT design and its implementation. Note that in the field all respondents first completed the IAT and then took part in the survey that measured explicit attitudes and self-reported imposed restrictions, where we follow the same sequence Beaman et al. (2009) used.

2.2 Self-reported survey measures

Measuring self-reported explicit attitudes proceeded in a straight-forward manner. Enumerators filled out a short survey with the respondents. The survey consists of six explicit attitude questions, six restrictive behavior questions and two control questions on age and gender of the parent. For the explicit attitudes measure, parents were asked to self-report on the extent they agree with six statements on a 4-point Likert scale. We deviate here from the standard 5-point Likert scale by omitting the neutral category. Evidence suggests the neutral category may be (mis) used if survey items are unfamiliar, or sensitive to social desirability (Kulas and Stachowski, 2009; Nadler et al., 2015). Each statement describes an activity that is traditionally seen as taboo during a girls' menstrual period. We carefully discussed this list of taboos with the implementing agency to ensure that this list was capturing all relevant activities that are generally recognized as taboo for a girl on her period in Bangladesh. We think of these questions as broadly reflecting normative beliefs. Table 3 - 1 presents the explicit attitude questions.

TABLE 3 - 1

SURVEY QUESTIONS EXPLICIT ATTITUDES TOWARDS MENSTRUATING GIRLS

1. A girl may cook whilst on her menstruating days
2. A girl may play with other children whilst on her menstruating days
3. A girl may go to school whilst on her menstruating days
4. A girl may eat white foods whilst on her menstruating days
5. A girl may wash clothes in a pond whilst on her menstruating days
6. A girl may pray whilst on her menstruating days

Notes: answer options were 1= totally agree, 2= agree slightly, 3= disagree slightly, 4= totally disagree

Next, we asked parents to indicate whether they impose restrictions on their daughters' activities during menstruation (Table 3 - 2). We maintain the same six activities as above, but the questions are now specifically targeted at the respondent's own daughter and can only be answered with "yes" or "no". We think of these questions as somehow capturing behavioral beliefs where subjective probabilities about the resulting outcome of this behavior produce favorable or unfavorable attitudes towards this behavior. In the context of *Ritu*, we may for example think the intervention alters parents' beliefs regarding the effectiveness of sending their menstruating daughters to school or the expected benefits of letting daughters play, cook, wash or eat white foods.

TABLE 3 - 2

SURVEY QUESTIONS ON PARENTS' IMPOSED RESTRICTIONS TOWARDS THEIR MENSTRUATING DAUGHTERS

Now I would like to ask you about any activities, social situations and foods that you would rather not allow your daughter to participate in when she is on her menstruating days
1. When your daughter is on her menstruating days, do you allow her to: Go to school?
2. When your daughter is on her menstruating days, do you allow her to: Cook?
3. When your daughter is on her menstruating days, do you allow her to: Play with friends?
4. When your daughter is on her menstruating days, do you allow her to: Pray?
5. When your daughter is on her menstruating days, do you allow her to: Eat white foods?
6. When your daughter is on her menstruating days, do you allow her to: Wash clothes in a pond or river?
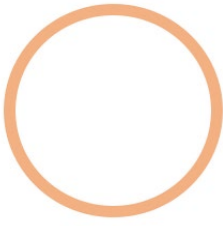
2.3 Implicit measure: The IAT

IATs are widely used to measure implicit attitudinal strengths or concept preferences. Respondents sit in front of a computer screen and only use two keys on the keyboard;

purple (left) and yellow (right). Their task is to pair a sequence of targets (girls on menstruating days or girls on regular days) and value stimuli (positive and negative words) as fast as possible. Respondents see pictures appearing one by one on the screen, or hear audio-recorded words one by one through headphones, and press the appropriate key; "purple" if the picture or word belongs to the category on the left side of the screen and "yellow" if it belongs to the category on the right side of the screen. There is only one single correct response (for example "bad" has to be classified under the negative category, denoted by a negative smiley emoticon). Participants go through a sequence of tasks, each called a 'block'. During each block the respondent is asked to correctly categorize a series of targets and value stimuli, and the IAT measures their relative speed and accuracy. The basic premise of the IAT is that a respondent is faster in pairing concepts like "a girl cooking on menstruating days" and "disgusting" if the respondent associates these concepts more easily than others, like "a girl cooking on menstruating days" and "good" (Greenwald et al., 2003; Vogt et al., 2017). The measure of implicit association is the D statistic - a measure of relative response time in millisecond per participant under the two different categorization schemes (Nosek et al., 2007). The D statistic is normalized with mean 0 and standard deviation 1 and ranges from -2 to 2. Negative scores indicate relative negative implicit associations with menstruating girls performing everyday activities, whilst positive scores indicate positive implicit associations.

Target Category

FIGURE 3 - 1

TARGET CATEGORIES

CATEGORY: GIRL ON MENSTRUATING DAYS	CATEGORY: GIRL ON REGULAR DAYS

For the IAT to work well, each stimulus must be identifiable as belonging to just one of four categories (Nosek et al., 2007). Here we have "girl on menstruating days", "girl on regular days", "positive" or "negative" words[5]. Previous literature has also stressed the importance of clearly defined categorization labels, so that categories are mutually exclusive (Lane et al., 2007; B. Nosek et al., 2007). Since most of our respondents are illiterate, we used icons to indicate the distinct categories. See Figure 3 - 1[6,7]. The icon for the menstruation category is based on the universal sign for menstruation used by international health organizations such as UNICEF and WaterAid and were pilot tested in this setting.

FIGURE 3 -2

PICTURES OF GIRLS DURING SIX DAILY SCENES WITH TWO BRAIDS AND BLUE DRESS (UPPER PANEL) AND PICTURES OF GIRLS DURING SIX DAILY SCENES WITH ONE BRAID AND GREEN DRESS (LOWER PANEL)

Source: RedOrange Media and Communications

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[5] *We avoid the use of negation in the category labels (i.e. not-menstruating) since negation delays the response time and hereby influences the IAT results (Lane et al., 2007)*

[6] *We use icons rather than neutral pictures of the girls as we would otherwise run the risk that respondents do not pay (sufficient) attention to the activities that girls perform, but rather select on the basis of dress color.*

[7] *As part of our pre-test we also conducted the well-known flowers-insect IAT developed by Greenwald et al., (1998)*

Target Stimuli

The target stimuli were illustrations of girls, being on their menses or not. We used newly defined target stimuli, previously unfamiliar to respondents, following the work of (Gregg and Banaji, 2006; Olson and Fazio, 2001; Vogt et al., 2017)[8]. Respondents would learn that either a girl in a green outfit with two braids always belongs to the 'menstruating days' category, and the girl in the blue outfit with one braid always belongs to the 'regular days' category or vice versa. The illustrations were designed by local Bengali artists and pilot tested for cultural sensitivity and equal likeability (following the method of Vogt et al., 2017). The girls are distinguishable by their outfit colors (green and blue) and hairstyles (one or two braids). Their facial expressions were identical, and as neutral as possible.[9] After the introduction, respondents answered a few control questions to check if respondents indeed "learned" (Olson and Fazio, 2001). Throughout the learning exercise, respondents were told to memorize the category the specific girl belongs to (Gregg and Banaji, 2006). The aim is to make respondents associate the two distinct girls with either being on their menstruating days or on their regular days. This learning of new target stimuli in IATs has been proven to be effective in other studies and can be done either implicitly or explicitly.[10] Yet given our setting, with the majority of respondents being illiterate and having very limited computer experience, we opted for an explicit learning exercise in the form of an introductory audio-recorded text in the local language.[11]

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[8] *The familiarity of the stimulus items has been shown to have little to no effect on the IAT measure, especially if it is held constant - as in our case (Dasgupta et al., 2003; Nosek et al., 2007; Ottaway et al., 2001).*

[9] *To ensure the girls are equally likeable we surveyed 20 individuals and asked them to rank the likability of the two girls on a scale from 1 to 5. Results showed that both the girl in the green outfit, and the girl in the blue outfit were very likeable and not significantly different from each other.*

[10] *See (Olson and Fazio, 2001) and (De Houwer et al., 2009; Gregg & Banaji, 2006; Lowes et al., 2015; Walther et al., 2011; Whitfield & Jordan, 2009) for examples of successful implicit learning techniques and Gregg & Banaji (2006) Efferson et al. (2015) and Vogt et al. (2017) for applications of successful explicit learning exercises in the context of an IAT.*

[11] *We have pilot tested the use of menstruation icons in the picture to see whether people learned faster. Yet participants then primarily classified according to the icons and not according to what they had learned about the dress color and its relation to menstruation. We therefore dropped all icons from the target stimuli pictures. Full learning text of the IAT can be found in Appendix 5 – (IAT Introductory text and illustrations)*

Since IAT effects are expected to be stronger when several stimuli are used per category instead of only one, we used six scenes as target stimuli (Nosek et al., 2007; Nosek, Greenwald, & Banaji, 2005). Also, instead of using multiple neutral scenes we selected activities that are particularly salient in our context. Figure 3 -2 details six daily scenes that are considered a taboo when girls are on their menses, following stringent social norms. These are (i) playing with friends; (ii) sitting in class; (iii) praying; iv) cooking; (v) eating a banana; and (vi) washing clothes. None of these activities are taboo when girls are not menstruating.

Value stimuli

We used positive and negative words as common used value stimuli (Efferson et al., 2015; Greenwald et al., 2003; Vogt et al., 2017). The value stimuli were audio recordings in the local language Bengali (also see Efferson et al., 2015; Van de Kamp, 2002; Vogt et al., 2017 for a discussion on the effectiveness of using audio IATs). We used five positive words, five negative words and indicated the categories with positive and negative emoticons similar to Vogt et al., (2017). See Figure 3 -3 for an overview of the value categories and auditory stimuli. Category labels (icon for menstruation and an empty circle, for the target stimuli and a happy and an unhappy smiley, for the value stimuli) were displayed for the entire duration of the blocks on the upper left or right side of the screen (Greenwald et al., 2003).

FIGURE 3 -3

VALUE CATEGORIES AND AUDITORY STIMULI

POSITIVE STIMULI	NEGATIVE STIMULI
Great	Bad
Good	Ugly
Amazing	Worthless
Beautiful	Disgusting
Okay	Unimportant

We had four different versions of the IAT since we counterbalanced the categorization rules and the characteristics of target stimuli across participants (Greenwald et al.,

2003; Vogt et al., 2017). Thus, half of the respondents learned that the girl in the green dress with two braids is on her menstruating days and the blue girl with one braid is on her regular days – whereas the other half of the respondents learned it the other way around. Also, half of our participants faced an initial categorization scheme where girls on their menstruating days are paired with negative words: the "congruent" condition, whereas the other half of the respondents started with pairing menstruating girls with positive words: the "incongruent" condition – also see Figure 3 -4.[12] We used Inquisit Lab 5.0 software to administer the IAT on laptops with headphones for audio instructions.

FIGURE 3 -4

CONGRUENT (LEFT PANEL) AND INCONGRUENT CONDITION (RIGHT PANEL)
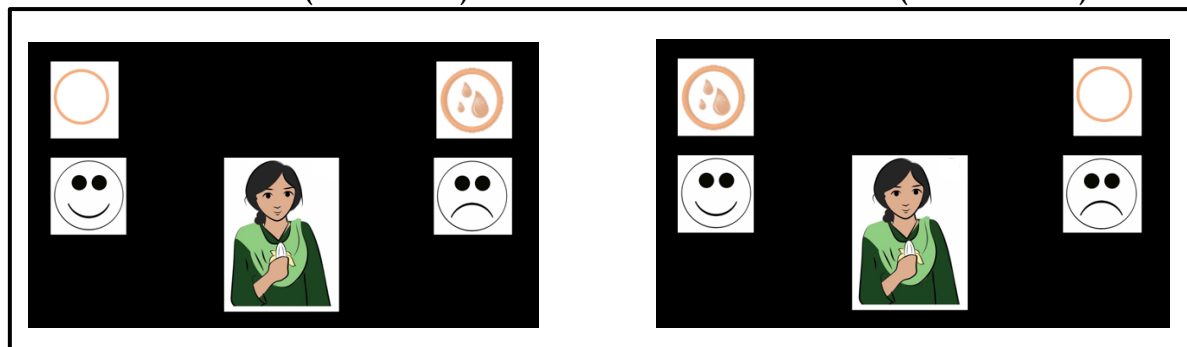
Our IAT follows the standard block structure[13] and counterbalancing rules of Greenwald et al. (2003). The counterbalance scheme was allocated evenly and randomly across the participants, allowing us to eliminate the potential of any artefacts associated with the girls' characteristics or the ordering of categorization rules to influence the results (Efferson et al., 2015).

All respondents complete seven blocks with the first two blocks practicing single cues, block three presents a practice block with the double categorization task on each side, while block four is the same as block three, but the actual test block. Block five, six and seven repeat the steps in the first three blocks, but with value stimuli switching sides. Thus, if the respondent had to categorize girls during their menstruation and negative

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[12] Table A - 1 in the appendix presents balance checks for the different treatment arms.

[13] see Table A - 2 for the block structure, in the appendix

words on the left side, in block five, six and seven negative words would now appear on the right-hand side together with the target category "'girls on their regular days". Respondents are unaware of the block structure, and the distinction between practice and test rounds. When respondents give the wrong answer, a big red X will appear in the screen and respondents cannot move on to the next word or picture until they hit the correct key (Greenwald et al., 2003). If they make too many mistakes or answer too slowly, their data will be discarded (Greenwald et al., 2003). The IAT is fully computerized (using Inquisit Lab 5). We adjusted the IAT for low levels of literacy and low experience with using computers (Bangladesh Demographic and Health Survey, 2016).

3 Results

In this section we test our main hypothesis: parental training coupled with improved on-school facilities and training on menstrual health may effectively leverage beliefs and attitudes surrounding menstruation. To this end we first examine whether explicit and implicit attitudes are (differentially) affected by the intervention and explore whether (i) some attitudes are more malleable than others and (ii) whether malleability co-varies with gender or age of the respondent. We subsequently investigate if explicit and (or) implicit attitudes also correlate with behavioral change (i.e., increased school attendance) as we observe in Sol et al., (2021).

Given the randomized design of the *Ritu* intervention we start our analysis with a straightforward differences-in-means comparison using a Wilcoxon rank-sum test. Table 3 - 3 presents the descriptive results. Explicit attitude measures are here displayed as the average score on a simple summative index with a minimum value of 6 if respondents would "totally agree" with all statements and a maximum value of 24 if respondents would "totally disagree" with all statements. Analogously, parental self-reported imposed restrictions are also presented in the form of a summative index with a minimum value of 6 if parents allow their daughters to do all six activities during their menstruation and a maximum value of 12 if they would answer "no" to each question.

TABLE 3 - 3

DESCRIPTIVE STATISTICS OF OUR MAIN TREATMENT EFFECTS

	CONTROL				TREATMENT				
	N	mean	Min	Max	N	Mean	Min	max	p-value*
Implicit attitudes score (range -2 +2)	221	-0.19	-1.30	1.21	246	-0.21	-1.49	1.12	(0.942)
Explicit attitudes score (range 6 -24)	231	13.9	6	24	263	10.1	6	19	(0.00)
Restrictive behavior (range 6 - 12)	231	9.30	6	12	263	7.47	6	12	(0.00)

*Notes: * p-value of Wilcoxon rank-sum test, two-sided. A higher D-score indicates more favorable attitudes towards menstruation. Lower scores on explicit attitudes and parental behavior indicate more favorable attitudes towards menstruation.*

The first row in Table 3 - 3 displays the mean D-score for our implicit measure for the treatment and control group, where a negative D-score indicates a relatively *negative* association, and a positive D-score suggests a relatively *positive* association between daily activities and menstruating girls participating in them. We follow the improved IAT scoring algorithm by Greenwald et al., (2009) removing error trials and replacing them with the mean of the respective performance block plus a penalty of 600 ms; deleting individual response latencies less than 400 ms; and deleting respondents for whom more than 10% of the trial responses were less than 300 ms.

While participants on average have slightly negative associations with menstruating girls performing daily routines, we see no significant difference between the treatment and the control group, suggesting *Ritu* did not affect average implicit attitudes.[14] Figure 3 - 5 presents kernel-density plots for both groups and shows the p-value of a two-sample Kolmogorov-Smirnov test (*p-value* 0.644), indicating the distributions are not significantly different from one another.

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[14] *We also ran an additional analysis where we excluded the slowest 10% and participants who had less than 75% immediately correct. Though still insignificant (p=0.21) results point in the same direction as those for explicit attitudes: the treatment group has on average more favorable attitudes towards girls doing daily routine activities while on their period than the control group. See Table A - 3 in the appendix for results.*

Contrast this with the findings on explicit attitudes and self-reported restrictive behavior in the second and third row of Table 3 - 3. Here we observe that explicit attitudes in the treatment group are significantly lower than in the control group. Note that a low score indicates more favorable attitudes towards menstruation – i.e., respondents were more likely to *agree* with the six statements related to practicing daily routines for girls while having their period. Thus, *Ritu* favorably impacted average explicit attitudes and self-reported restrictive behavior towards menstrual taboos.

Yet not all menstrual taboos are equal, and some are plausibly more malleable in response to an intervention than others. In Table 3 - 4 we therefore look at each activity separately. We indeed see that some norms are more responsive to change than others. Eating white foods is considered totally unacceptable for 50% of the respondents in the control group (column 5) compared to only 11% in the treatment group (column 10). Also, 16% in the control completely disagrees with the idea that menstruating girls can play with other children, against only 1% in the treatment group. The last column

reports the *p-value* of a Wilcoxon rank-sum test and shows attitudes related to cooking, playing with children, going to school, eating white foods and wash clothes in the river, are all significantly affected by the *Ritu* intervention and in the same direction; treatment respondents have more favorable attitudes towards girls performing these activities during menstruation than respondents in the control group. Only attitudes towards praying during menstruation are not affected: more than 90% in both groups report to "totally disagree" with the statement that a menstruating girl may pray. This is hardly surprising given the importance of religion in daily life in the region and the well-known persistence of religious values and norms (Inglehart and Baker, 2000).

TABLE 3 - 4
EAT SCORE PER SPECIFIC NORM

	CONTROL				TREATMENT						
	mean	++	+	-	- -	Mean	++	+	-	- -	Treatment effect	p-value*
A menstruating girl may:												
Cook	1.72	58%	23%	6%	12%	1.13	91%	6%	0%	2%	0.59	0.00
Play with children	1.92	48%	26%	10%	16%	1.19	87%	9%	3%	1%	0.73	0.00
School	1.55	65%	22%	6%	7%	1.05	97%	2%	1%	0%	0.50	0.00
Eat white foods	2.84	22%	22%	6%	50%	1.51	76%	9%	4%	11%	1.34	0.00
Wash cloths in river	2.02	48%	21%	10%	20%	1.33	76%	17%	3%	3%	0.70	0.00
Pray	3.82	1%	7%	1%	91%	3.86	2%	3%	1%	94%	-0.04	0.23

*Notes: ++ totally agree; + slightly agree; - slightly disagree; -- totally disagree. The treatment effect measures the difference in mean scores for a specific activity between the treatment and control group. * p-value of Wilcoxon rank-sum test, two-sided*

We now turn to parental imposed restrictions for their daughters. Recall that we use the same six activities that are considered taboo for a girl during menstruation but now ask parents whether they allow their own daughter(s) to perform these activities. Table 3 - 5 presents the results.

TABLE 3 - 5
PARENTAL- IMPOSED RESTRICTIONS PER SPECIFIC NORM

	CONTROL		TREATMENT		
	YES	NO	YES	NO	p-value*
My menstruating daughter is allowed to:					
Cook	56%	44%	92%	8%	0.00
Play with children	65%	35%	96%	4%	0.00
School	67%	33%	97%	3%	0.00
Eat white foods	27%	73%	82%	18%	0.00
Wash clothes in river	52%	48%	79%	21%	0.00
Pray	3%	97%	7%	93%	0.02

* p-value of Wilcoxon rank sum test, two-sided

We see results that are fairly consistent with their explicit attitudes – overall there is a clear *Ritu* treatment effect with some norms more malleable than others like "eating white foods" where we see the largest difference between the two groups. The last column is the *p-value* of a two-sided Wilcoxon rank-sum test. In contrast to the explicit attitudes, we now also observe a small significant impact on being allowed to pray. This effect is however based on a very small number of respondents answering "yes" to this question (19 in the treatment group and 6 in the control group) and clearly an overwhelming majority in both groups (more than 90%) does not allow their daughter to pray while on her period.

In Table 3 - 6 below we also check whether self-reports from parents on "my daughter is allowed to go to school during menstruation" are aligned with a direct question (row 1) on whether their daughter misses any days of school during her period. Here we find a significant difference (38 percentage points) between the two groups, where parents in the treatment group are less likely to indicate their daughters miss school during menses. We also ask for the number of days their daughters miss school and observe that while this is approximately 1.8 days in the control group this reduces to 0.3 days in the treatment group.

TABLE 3 - 6
CROSSCHECK, SELF-REPORTED ATTENDANCE DAUGHTER

	CONTROL		TREATMENT		TREATMENT EFFECT	
	n	%/mean	n	%/mean	%/mean	p-value*
1. Does your daughter miss any days of schoolings when on menses?	231	59% yes	263	21% yes	-38%	0.00
2. How many days?	200	1.8 days	242	0.3 days	-1.5 days	0.00

* p-value of Wilcoxon rank sum test, two-sided, control vs treatment

All in all, we find results consistent with the idea that the *Ritu* intervention affected parental attitudes towards menstruation. We find no evidence that *Ritu* affected attitudes of mothers and fathers differently, nor that the age of the parent matters (see results in appendix, Table A - 3 and Table A - 4).

As a next and final step, we examine the extent to which parental implicit and explicit attitudes correlate with one of our key behavioral measures; school attendance as measured by school administrative records. To this end we matched parental results

from our implicit and explicit attitudes exercise with information about their daughter's absence using administrative school record data as in Sol et al., (2021).

Table 3 - 7 presents the results. Columns (1 & 2) show a weak negative correlation between IAT D-score and school absence: girls have lower school absence rates if their parents have more favorable *implicit* attitudes, but the coefficient is relatively small. Columns (3 & 4) reports girls to have higher absence rates if their parents' *explicit attitudes score* is higher, i.e., they have more unfavorable *explicit* attitudes, and column (5 & 6) also shows that absence is higher if parents are more restrictive. These are clearly mere correlations as the *Ritu* intervention may have simultaneously affected beliefs, attitudes and behavior. Yet it is interesting to see that implicit attitudes do not seem to be strongly correlated with behavioral change while explicit attitudes and self-reported restrictive behavior are. We speculate that implicit attitudes are more reflective of social norms and deep preferences that are not easy to change while our explicit attitudes and imposed restrictions capture normative and behavioral beliefs that are much more amenable to change - at least in the short run - in response to an intervention like *Ritu*. The next section elaborates on these and alternative explanations.

TABLE 3 - 7

CORRELATIONS BETWEEN IMPLICIT, EXPLICIT ATTITUDES, PARENTAL-IMPOSED RESTRICTIONS AND MATCHED SCHOOL ABSENCE DATA OF THEIR DAUGHTERS

	SCHOOL ABSENCE RATE OF DAUGHTER					
	(1)	(2)	(3)	(4)	(5)	(6)
IAT score	-0.007*	-0.010***				
	(0.004)	(0.003)				
EAT score			0.022***	0.019***		
			(0.005)	(0.005)		
EB score					0.046***	0.036***
					(0.013)	(0.013)
Constant	0.372***	0.537***	0.107	0.300**	-0.011	0.240*
	(0.035)	(0.108)	(0.108)	(0.114)	(0.121)	(0.125)
Mean dependent^	0.373	0.373	0.373	0.373	0.373	0.373
Observations	275	275	243	243	243	243
Controls^^	NO	YES	NO	YES	NO	YES

Notes: ^ mean value of the dependent variable: girl school absence rate ^^We controlled for stratification variables (sub-district (7 Upazilas), quality of school toilet facilities at baseline (high/low), average girl school attendance per school at baseline (high/low). Clustered standard errors on school level in parentheses. IAT score is the D-score on the Implicit Attitudes Test. EAT score is the index score on the explicit attitudes questions and EB score is the index score of self-reported restrictive behavior.

4 Discussion

Using an RCT, this study investigates whether a menstrual health program causally affects parental beliefs and attitudes towards menstruation. The menstrual health program is a multi-faceted program following a two-pronged approach: 1) a school-based intervention targeting teachers and pupils in grade 6-8 and 2) an additional household component complementary to the school-based intervention, whereby parents receive a two-day training on the importance of sound menstrual health. This second component might be of relevance given the instrumental role of parents in deciding whether or not their daughter(s) are able to take part in daily activities during their menstruation. The main focus of this paper is the parents, so we focus on the combined intervention where parents are directly trained in addition to the treatment their daughters receive at school. This means that any effect we find can be attributable to the household-level treatment, the school-based treatment or both. The household-level component offered in parents' communities aims to increase knowledge about reproductive health, menstrual health and instructions on how to best support menstruating girls. Attendance rates of parents in these sessions was

high, which can shape parents' attitudes. In addition, parents may change their attitudes in an indirect way through their daughter's school-based program. We tested the impact of the combined intervention on implicit attitudes, explicit attitudes and parental-imposed restrictions for girls during their period.

While implicit attitudes remain unchanged, we do see significant improvements in explicit attitudes and parental-imposed restrictions. If there is an absence of strong real behavioral impacts, one may be inclined to attribute these results to social desirability or experimenter demand bias. Yet we know from our companion paper that *Ritu* also has strong impacts on school attendance, which is measured in an objective way, suggesting these behavioral impacts may have partially come about through changes in parental attitudes. We also think the *Ritu* intervention lends itself well to (re)shaping beliefs and attitudes that are associated with behavioral intentions and behavioral change (Fishbein and Ajzen, 2010) but may be less suited to erode deeply held preferences - at least in the short term. Consider its provision of menstrual health-friendly toilets at school and available government subsidies to improve toilet facilities at home. This would arguably affect control beliefs – broadly defined as having the abilities and facilitating environmental conditions to carry out the desired behavior. Lastly, the comprehensive (all-inclusive) nature of *Ritu*, by providing hardware (improved toilet facilities for all) and software (in the form of educational training for teachers, girls, boys and parents) may have affected so-called normative beliefs - the extent to which individuals believe that others approve or disapprove of them performing this behavior.

What about implicit attitudes? If, as commonly believed implicit attitudes reflect deeply ingrained preferences, a program like *Ritu* may not be able to change them, or at least not within the time-span of this study. At the same time, preference change does not seem to be necessary for important behavioral change (increased school attendance) to come about. While we found a positive correlation between more progressive attitudes and increased school attendance, the coefficient was relatively small, suggesting that implicit attitudes as such have little influence on parents' practical decisions like sending their daughters to school.

A caveat to our study is that we are not able to answer questions related to underlying mechanisms – do parents change their attitudes because the program made them more aware of traditional menstrual health practices jeopardizing girl's health, i.e. mitigating specific knowledge constraints; or because it increased empathy and perspective-taking facilitating a more supportive culture at home; or are they made more aware of potentially divergent views within families or communities on what girls can and cannot do during their menstruation? New studies may want to investigate underlying channels in a very explicit manner for example through setting up mechanism experiments where one randomly varies the extent to which parents are trained in empathy and perspective-taking or exposed to locally conflicting views on menstrual taboos and constructive ways to resolve such conflicts. Also, similar in spirit to Beaman et al. (2009), future work could use multiple IATs – where next to a taste-based IAT as we conducted in the present study, one could develop a second one that tests whether parents would see menstruating girls as able as girls not on their period, to perform certain tasks. A second caveat pertains to the sustainability of our effects. We document short-term effects observed after one year and we cannot say to what extent our results sustain. Future research can document effects over the longer run.

5 Conclusion

Adolescent girls in Bangladesh and many other places in the world are subject to social and cultural norms regarding menstruation that prohibit partaking in daily activities like going to school, playing with others, cooking, washing, eating certain foods, and religious activities during their menses, thereby inhibiting girls' development and wellbeing. Our findings provide some of the first robust evidence of the role of (public) menstrual health programs like *Ritu* on parental attitudes that possibly provide a first step towards mitigating adverse outcomes for adolescent girls. We find significant positive changes in explicit attitudes and parental-imposed restrictions. While encouraging, deep preferences and strong norms related to menstruation seem to be largely unchanged as suggested by our IAT results and attitudes towards the arguably most stringent menstrual taboo of girls partaking in religious activities

during their period. This is also perhaps unsurprising as strong cultural norms and taboos surrounding topics like menstruation are unlikely to change overnight. Yet, if programs like *Ritu* set in motion attitudinal and behavioral changes both among parents and girls this may create new dynamics, experiences, insights and opportunities that facilitate desirable changes in preferences and social norms in the long term.

6 Appendix

Appendix 1 - Counterbalance checks for the IAT

Table A – 1 presents the p-values of Kruskal-Wallis tests, examining the implicit attitudes scores of the congruent version versus the incongruent version, and the blue version versus the green version. We also tested for joint orthogonality across all 4 versions, and found a p-value of 0.527. The table shows that the implicit attitudes D-score is not affected by whether respondents are first exposed to the congruent or incongruent condition, nor whether they had to remember that the girl in the blue dress was having her period vis-à-vis respondents that had to remember the girl in green being on her menses.

TABLE A - 1

VARIABLES	CONGRUENT		INCONGRUENT		K-W TESTS
	N	mean	N	Mean	p-value
Implicit attitudes score	233	-0.202	234	-0.197	0.607

VARIABLES	BLUE ON MENSES		GREEN ON MENSES		K-W TESTS
	N	mean	N	Mean	p-value
Implicit attitudes score	279	-0.190	188	-0.213	0.669

Appendix 2 – Block structure of the IAT

TABLE A - 2

BLOCK STRUCTURE OF THE IMPLICIT ASSOCIATION TEST

Blocks	# Rounds	Stimuli
1. Practice	20x	Target stimuli
2. Practice	20x	Value stimuli
3. Test	20x	Target & Value stimuli
4. Test	40x	Target & Value stimuli
5. Practice	20x	Reversed Value stimuli
6. Test	20x	Target & Reversed value stimuli
7. Test	40x	Target & Reversed value stimuli

Appendix 3- Heterogeneous treatment effects

We find no evidence that *Ritu* affected attitudes of mothers and fathers differently, nor that the age of the parent matters. See Table A – 3, and Table A – 4.

TABLE A - 3

REGRESSION ESTIMATES: TESTING FOR HETEROGENEOUS TREATMENT EFFECTS ON GENDER

	IAT SCORE	EAT SCORE	EB SCORE
	(1)	(2)	(3)
Treated	-0.057	-3.864***	-1.871***
	(0.053)	(0.410)	(0.174)
Female	-0.047	-0.374	-0.096
	(0.000)	(0.000)	(0.000)
Female * Treat	0.080	0.084	0.078
	(0.074)	(0.574)	(0.244)
Constant	-0.167***	14.071***	9.348***
	(0.039)	(0.301)	(0.128)
Observations	467	494	494

Notes: IAT score is the D-score on the Implicit Attitudes test. EAT score is the index score on the explicit attitudes questions and EB score is the index score of self-reported restrictive behavior. Treated is a binary variable, 1(treatment group) 0 (control group). Female is a binary variable, 0 (Male) 1 (Female).

TABLE A - 4

REGRESSION ESTIMATES: TESTING FOR HETEROGENEOUS TREATMENT EFFECTS ON AGE

	IAT SCORE	EAT SCORE	EB SCORE
	(1)	(2)	(3)
Treated	-0.260	-5.333**	-1.667
	(0.326)	(2.608)	(1.109)
Age = 30-39	-0.226	-1.152	0.627
	(0.236)	(1.885)	(0.801)
Age = 40-49	-0.161	-0.609	0.713
	(0.234)	(1.876)	(0.797)
Age = 50-59	-0.160	-0.197	0.782
	(0.237)	(1.900)	(0.808)
Age = 60-69	-0.063	-1.778	0.167
	(0.249)	(1.992)	(0.847)
Age = 70-79	-0.061	-1.267	0.133
	(0.291)	(2.333)	(0.992)
Treated * Age (30-39)	0.336	1.819	-0.114
	(0.333)	(2.663)	(1.132)
Treated * Age (40-49)	0.150	1.186	-0.361
	(0.331)	(2.648)	(1.126)
Treated * Age (50-59)	0.319	1.382	-0.122
	(0.335)	(2.682)	(1.140)
Treated * Age (60-69)	0.261	2.257	0.333
	(0.353)	(2.830)	(1.203)
Treated * Age (70-79)	-	0.933	-0.133
		(4.364)	(1.855)
Constant	-0.023	14.667***	8.667***
	(0.230)	(1.844)	(0.784)
Observations	464	491	491

Notes: IAT score is the D-score on the Implit Attitudes test. EAT score is the index score on the explicit attitudes questions and EB score is the index score of self-reported restrictive behavior. Treated is a binary variable, 1(treatment group) 0 (control group). Age is a categorical variable, range 2-7. Age category (20-29) is the comparison group and thus omitted from the regression.

Appendix 4 – Study area

Netrakona

Bangladesh

0   50   100   150   200 km
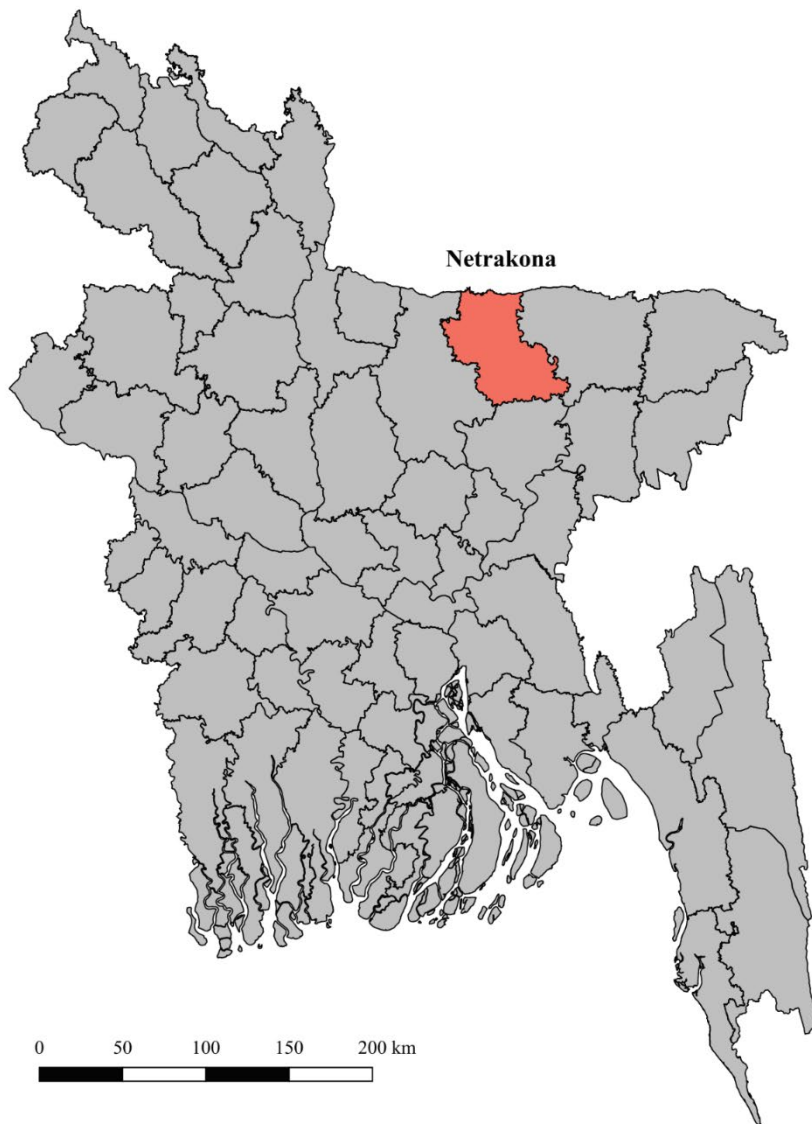
Appendix 5 – IAT Introductory text and illustrations

In the IAT, we counterbalanced which girl is on her menstruating days and which girl is on her regular days. We therefore have two versions of the introductory text, one for when the girl with 1 braid and the green outfit is on her menstruating days, and one for when the girls with 2 braids and the blue outfit is on her menstruating days. This is the English version of the text, the IAT was administered in Bengali. The version below, depicts the version where the girls with 1 braid and the green outfit is on her menstruating days and the other girl on her regular days.

| 1. | ' Look at the two girls on the screen, the girl in on the left is Rina and the girl on the right is Mim. Rina and Mim are good friends, they live in the same village and are the same age.

Just like most girls, Rina and Mim have had their menarche and since then they have their menstrual days once a month. During this time, they menstruate and usually experience some pains in their lower stomach.

Look at the girl on the left. She lives with her mother, her father and 2 siblings. She is currently on her menstrual days. To remind you that she is on her menstrual days, she is wearing a green outfit with a green scarf, and she wears her hair in 1 braid.

Look at the girl on the right. She lives with her mother, her father and 3 siblings. She is on her regular days, and is not menstruating. To remind you that she is on her regular days, she is wearing a blue shirt, a blue scarf and has 2 braids.

In the next step I will tell you a bit more about them.

Please press the white long key in front of you to go to the next step |
|---|---|
| 2 | Look at the girl again, this girl is currently on her menstruating days. She looks a bit different than her friend. Remember, she is wearing a green outfit and 1 braid in her hair – to remind you that she is on her menstrual days. You will have to remember that she is on her menstrual days.

Take a good look at her, see her green outfit and her braid – remember that she is currently on her menstruating days. Once you're done looking, and you have remembered - press the white long key in front of you |

3	Look at the girl, this girl is currently on her regular days, she is not menstruating. She looks a bit different than her friend. Remember, she is wearing a blue outfit and 2 braids in her hair – to remind you that she is on her regular days. You will have to remember that she is on her regular days. Take a good look at her, see her blue outfits and her 2 braids – remember that she is on her regular days. Once you're done looking, and you have remembered - press the white long key in front of you.
4	Now you see the same two girls, performing several activities: They are: eating banana – praying – cooking – washing clothes in a river – playing with friends – sitting in class at school. Throughout the exercise today, you will see these photos one by one. All you have to do for now, is just remember which girl is on her menstrual days (the girl in the green outfit) and which one is on her regular days (the girl in the blue outfit). Please take a careful look at all the pictures, and press the white long key in front of you once you're done
5	Later on in the exercise, you will also hear 10 different words. These words are either positive or negative. Look at the smileys on the screen, one smiley is smiling and represents positive words. One smiley looks sad, and represents negative words. You will now hear the 5 positive words we will be using: Great, good, amazing, okay and beautiful. Those were the positive words, now you will hear the 5 negative words: Worthless, ugly, unimportant, bad, disgusting. Thank you for listening, please press the white long key in front of you
check 1	Look at the 2 girls on the screen, you have seen them before. Please tell me: which one is on her menstrual days? Press the purple key if you think it is the left one, and press the yellow key if you think it is the right one.
6	Now that you have been introduced to the two girls and have heard the positive and negative words, I will explain the exact exercise that you will do. The total exercise will take you about 10 minutes. In this exercise, I will ask you to categorize items. In the next exercise, we will show you pictures of the two girls. You will see these girls doing the activities you just saw, so: playing, cooking, washing clothes, praying, eating a banana or being in class. After, we will ask you if the girl you are seeing, is on her menstruating days or on her regular days. Put your index fingers on the yellow and purple keys of your keyboard, and press the long white key in front of you when you are ready to start
7	We will ask you to categorize the pictures of the girls, into two categories: girl on menstruation days and girl on regular days. These categories are represented by the icons you see on your screen, on the left you see an empty circle, this represents a girl on her regular days. On the right, you see a circle with drops, this represents a girl on her menstruation days. In the next task, you will see pictures of the girl and we ask you if she is on her regular days or menstruation days, you will answer by pushing either the purple or the yellow key. Please press the white long key in front of you when you are ready Let's start with a practice round. If you make a mistake, a red cross will appear – you can fix the mistake by hitting the other key.
check 2	You see the categories on the screen, the purple key belongs to the left category and the yellow key belongs to the category on the right. In the middle, you see a picture: is this girl on her menstruation days or on her regular days? You can answer, by either pressing the purple key or the yellow key. If you make a mistake, a red cross will appear - you can fix the mistake by hitting the other key

Chapter 4

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Chapter 5

General summary

Having the intention to 'do good' does not automatically lead to positive impact – there are countless little steps between having good intentions and making lasting sustainable impact. In the private sector, it is standard practice to track money; we follow the input costs, track how it generates revenue and calculate profit margins. In the development sector, we approach impact in a similar way; we follow the costs of our actions, track how many people are affected and calculate how much impact is generated. In this dissertation I take a similar approach in assessing the impact and cost-effectiveness of Menstrual Health interventions in Bangladesh. We performed a needs assessment at the start to make sure the intervention filled the right gaps, we kept track of all the costs, and used mixed method to measure the impact on the wellbeing and development of adolescent girls in Bangladesh.

In Chapter 2, I study changes in menstrual health outcomes, wellbeing outcomes and educational outcomes of adolescent girls. I use a randomized controlled trial experimental design to show the causal link between the *Ritu* Menstrual Health program and positive changes in the lives of girls. 149 schools were randomly assigned to receive menstrual health interventions at school, or receive menstrual health interventions at school *and* at the households, or to be in the control group. I showed significant improvements in outcomes related to their Menstrual Health, such as more hygienic practices, more support and better wellbeing during menses. I also found rigorous evidence that school attendance of menstruating girls increased compared to their peers who did not receive the *Ritu* program. School attendance of boys also increased, which can be accredited to the holistic approach of the program: boys were specifically targeted with this program, since they play a key part in creating a more open and supportive environment for girls to practice safe MH and be included in society during their menses. Future research could shed more light on the effect on boys, and it could also provide more evidence on the exact pathways of change and if certain aspects of the holistic menstrual health intervention were more effective than others. New studies could also look at longer term effects, and examine how menstrual health interventions during adolescence affect long term development

outcomes of girls, and the way they interact and support their own offspring. This might seem far away, but the girls who received menstrual health interventions in school are likely to soon be mothers themselves, since the average age at first birth is 18 years in rural Bangladesh. It is therefore extra interesting to examine generational effects, and investigate if menstrual barriers for the next generation are lower than they were for the current generation due to menstrual health interventions.

The menstrual health program was thus successful at positively affecting the lives of young girls and boys. For policymakers though, it is important to also know the exact costs involved before deciding whether to upscale programs such as these. Therefore, I examined the cost-effectiveness of implementing the program. I find that the *Ritu* program was relatively cost-effective, and the school program version was more cost-effective than the combined program. The difference in cost-effectiveness estimates of the two versions of the program (school-based vs combined program) is not driven by differences in impact results but rather by differences in costs – with the combined program (specifically the household component) being considerably more costly than the school program. The cost-effectiveness findings lie within the range of existing evidence, meaning that the *Ritu* program measures up to other programs (such a purely education programs) in terms of increasing school attendance of adolescents and improving development outcomes. These findings are important for policymakers, who now have clear evidence that a well-targeted and holistic menstrual health intervention can provide similar outcomes in terms of education as other programs can, and it can do so at similar costs. It should be noted that cost-effectiveness results always rely heavily on assumptions, that is why we made the conscious decision to use a conservative method and our cost-effectiveness results should therefore be interpreted as lower-bound estimates. The true cost-effectiveness of the *Ritu* program, in terms of benefits beyond school attendance such as wellbeing and future development outcomes, is likely to be larger. Future research could compare the implementation costs of the *Ritu* program with the long-term impact results, for example by surveying the participants 5 to 10 years from now.

The menstrual health sector is in need of more evidence on the cost-effectiveness of menstrual health interventions, new studies on this topic should disclose cost information as much as possible so that the cost-effectiveness of different types of MH interventions becomes clearer. This way, decision makers can make evidence-informed decisions about what type of MH intervention could support the development of girls and women the most.

In chapter 3 I take a closer look at the social norms and attitudes inhibiting girls and women from reaching their full potential during their periods. Specifically, I examine if the *Ritu* program causally affects the attitudes of mothers and fathers and if certain restrictive norms are more malleable than others. Parents play a pivotal role in deciding what their daughters are allowed to do during their menses. I find that implicit attitudes (or: deep preferences) for parents towards menstruation remained unchanged, but the program significantly improved explicit attitudes and parental-imposed restrictions on menstruating daughters. I also find that attitudes towards certain taboos (especially the ones rooted in religion) were less likely to change than others. This means that the *Ritu* program managed to achieve a change in explicit preferences and decision making of parents, which is one potential explanation for the positive behavioral changes we found in Chapter 2, with girls for example coming to school more often. There is plenty of opportunity for new research to delve deeper in the underlying channels of how parental behavior changed due to a menstrual health intervention, as well as testing new methods of eliciting implicit attitudes.

Adolescent girls face a multitude of challenges to their development and wellbeing in general, and during menses these challenges often become even greater. Especially in low- and middle- income countries, menses is often met with less acceptance, social exclusion and poor menstrual health. Menstrual health interventions have the potential to contribute to girls' livelihoods, mobility, education and reproductive health, and life skills for both boys and girls, improving their future outlook. A girl has to manage menstruation on average 3,000 days throughout her life (Ahmed and Yesmin, 2008). This dissertation provides rigorous evidence showing that addressing

issues related to MH has the potential to not only improve outcomes during these 3,000 days but also far beyond.

Chapter 6

Research impact

Bangladesh currently ranks number 110 (out of 129) on the SDG gender index[1] , clearly indicating that women and girls have big hurdles to overcome to thrive in this country and be seen and treated as equal to men. In this dissertation, I worked closely together with an NGO (Simavi) to find ways to improve this situation for adolescent girls and measure the effects. The findings of this dissertation aid policymakers in their decision making on how to make sure females are no longer left behind but included in society and make valuable contributions to society and the economy as a whole. The relevance of the findings of this dissertation are not unique to Bangladesh, since almost every country in the world struggles with achieving gender equality, improving menstrual health and making sure women can thrive and be a valuable contribution to society.

In this dissertation I look at how the lives of girls, their peers and their parents are changed due to a menstrual health intervention in Bangladesh. I use different methodologies to uncover pathways of change, and examine if and how the intervention had an effect on the personal development of girls, for example by measuring outcomes related to their empowerment, menstrual health, support and attitudes. Next to effects on outcomes for girls, I also examine schooling effects on boys, and changes in attitudes and behavior of parents. I also look at the cost-effectiveness of the program, which is particularly useful for decision makers.

Impact on general evidence base

This research is an important addition to the small global evidence base on menstrual health, it provides evidence on i) the impact of Menstrual Health programs, ii) measurement of Menstrual Health related outcomes and iii) cost-effectiveness estimates.

This dissertation shows that Menstrual Health interventions can have positive effects on menstrual health outcomes, but also on other important pillars for future

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[1] *Equal Measures, 2019. Harnessing the Power of Data for Gender Equality: introduction the 2019 EM2030 SDG Gender Index.*
https://reliefweb.int/report/world/harnessing-power-data-gender-equality-introducing-2019-em2030-sdg-gender-index

development – such as support, confidence and education. The results on education provide clear and rigorous evidence that girls and boys come to school more often due to the menstrual health program. It not only shows the potential of such interventions on raising the education level of girls and women, it also makes a strong case for using multiple data sources to verify results on educational outcomes. Measuring effects on school attendance is challenging but it is important to invest in rigorous data collection methods to uncover correct pathways of change. In our example, we found out that the increase in school attendance is not solely driven by girls coming to school more often during their period, but by coming to school more often *in general*. This general positive effect on school attendance was also observed for the boys in their classes, who also came to school more often. The effect on the behavior of boys and their school attendance is an important finding and can be attributed to the inclusive nature of the *Ritu* program. The program specifically included boys and fathers in the program, because change in society cannot come about when you exclude 50% of the population. We find the same when we look at the impact on parents, where the positive change in attitudes of fathers is just as strong as the effect on mothers. These findings show how important it is to also target the male population in menstrual health interventions.

Next to evidence on the impact of the intervention, this research also informed measurements for menstrual health research. At time of baseline, there were hardly any standardized modules for testing menstrual health related outcomes. Therefore, our methodology relied on a comprehensive effort to measure MH outcomes in multiple ways. This research added to the evidence base on different ways of measuring menstrual practices, confidence, menstrual knowledge and attitudes towards menstruation. For example, I used the data of this research to co-author a paper on the importance of distinguishing between the home environment and school environment when measuring confidence in menstrual practices (Hennegan and Sol, 2019). The data was also used in another co-authored paper that stressed how important it is to measure awareness of menstruation prior to menarche (Hennegan et al., 2022).

Immediate impact of this research

Next to adding to the general evidence base on menstrual health – which is likely to have substantial long-term effects – the research presented in my dissertation has already created immediate impact as well.

During the implementation phase of the *Ritu* program, the implementing NGOs (Simavi, BNPS and DORP) set up a national Menstrual Hygiene Management Platform with the sole purpose to learn from each other and share all information and inform other programs and policies. Members include other NGOs working on sanitation, sexual and reproductive rights and menstrual health, United Nations agencies, national and international research institutes, the public sector and the private sector. Amongst others, the findings of this dissertation were shared with all members of the platform. The platform is still up and running and working on joint advocacy for menstrual health.

Another clear example of how this dissertation has had an impact, is that the national school curriculum in Bangladesh will be altered to include menstrual health based on the menstrual health manual created by the *Ritu* program. The local implementing NGO (BNPS) met with the National Curriculum and Textbook Board of Bangladesh, who confirmed that they used parts of the manual and it will be included in the schoolbooks gradually. One of the other local implementing NGOs (RedOrange) used the findings of the *Ritu* program in their efforts to inform the national menstrual health strategy for Bangladesh. RedOrange was in close contact with the Directorate General of Family Planning of the Ministry of Health and Family Welfare, to discuss a dissemination plan. In the end, the line director of the Information, Education and Motivation Unit of this directorate, confirmed that the *Ritu* materials will be utilized in future awareness activities and made available on their official website.

I would like to stress that while it was the findings of this dissertation that provided the much-needed evidence to show the effectiveness of menstrual health programs in Bangladesh, it actually was the relentless advocacy work of the local NGOs that caused the findings to land in the right hands and be turned into action. Full credit for

this great advocacy success should therefore go to BNPS, DORP, RedOrange and the local Simavi team in Bangladesh.

Next to the national level impact, this research also generated clear impact beyond Bangladesh. First, the Dutch implementing NGO (Simavi) took many lessons learned throughout the program and applied them to their other programs in numerous other low-income countries. For example, they used it to i) inform their future Menstrual Health programs, ii) measuring the impact of their other programs more rigorously, and iii) by weaving 'evidence-based-policymaking' into their modus operandi. Additionally, the long-term impact of them openly sharing cost-effectiveness information should not be understated and will aid other policymakers and NGOs in their decision making. Second, Simavi used the findings of this dissertation (ie. the impact results of the *Ritu* program) to provide capacity-building workshops for 40 other global NGOs and train them on menstrual health interventions and successful advocacy. Third, throughout the entire research process, all findings and protocols have been openly shared with the global menstrual health community and everyone working in this space. I have attended and presented at conferences, hosted workshops with policymakers, and have been actively involved in the menstrual health community by giving guest lectures and interviews. This research provides one of the first truly rigorous findings on how menstrual health interventions can change lives for the better, and disseminating the findings has been the priority of everyone involved in the *Ritu* program.

Next to evidence on impact and measurement standards, this research is one of the first to clearly compare the benefits of menstrual health interventions with their costs. In the end, policymakers need to decide where to allocate their limited resources, and having cost-effectiveness estimates (even though they are for-from-perfect) definitely aid them in their decision-making process. The findings are particularly valuable in shaping policies to enhance the development and potential of women, and it also aids policymakers in making decisions around social norms and building life skills for both boys and girls to build a culture of respect, inclusivity and dignity. If we are serious about reaching the Sustainable Development Goals, we need to critically look at the

impact of our endeavors and be transparent about the costs, only then can we focus on helping the most people with our limited funds, and make sure no one is left behind.