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Information, Choice and Menstrual Outcomes: Evidence from a Community-Based Intervention in India

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Information, Choice and Menstrual Outcomes: Evidence from a Community-Based Intervention in India

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Abstract

Public policy, commercial interests and cultural taboos, and have collectively shaped menstrual outcomes in developing countries such that disposable pads gained in popularity, yet knowledge of menstrual hygiene and of reusable alternatives remained low and levels of period poverty remained high. Drawing on a community-based intervention with 277 women from India, we examine if information and choice matter for menstrual outcomes. Exposure to information and access to alternatives significantly increased preference for reusables and better waste management practices. It also improved knowledge of menstrual management and alternatives, however traditional beliefs around menstruation remain entrenched. We conclude that while prevailing informational asymmetries challenge a wider take-up of reusables, informed choice, as a policy tool, has the potential to sustainably reduce period poverty.

Key words: period poverty, menstrual hygiene management, asymmetric information, informed choice, period products, India.

1. Introduction

Globally, one in four girls and women of menstruating age live in conditions of 'period poverty'.[1] This is when menstruators have "inadequate access to menstrual hygiene tools and education, including but not limited to sanitary products, washing facilities, and waste management" (American Medical Women's Association, 2019). Girls and women in developing countries experience a disproportionate burden of period poverty, not only due to high levels of absolute poverty but also because 85% of the world's 2 billion menstruators live in these countries (UN, 2019). These unmet menstrual needs have important consequences for their health, education, employment, and wellbeing, impeding progress across multiple Sustainable Development Goals (Sommer et al., 2021a; 2021b).

Growing advocacy to address menstrual needs has urged governments and non-governmental organisations to respond. Internationally, efforts to mitigate period poverty have mainly favoured the provision or access to sanitary materials, which has largely been managed via the pledge to distribute free or discounted disposable sanitary pads (House, Mahon and Cavill, 2012; Garg, Goyal and Gupta, 2012; African Coalition for MHM, 2019). An emerging concern is that these efforts have focussed on disposable pads and ignored other

[1] Author's estimates: Girls and women of ages 13 through 51 constitute 26% of the 7.8 billion people worldwide (World Population Datasheet, 2020). Assuming that the vast majority of them have periods, gives a global estimate of ~2 billion menstruators. Globally, at least 500 million girls and women lack adequate facilities for menstrual hygiene management (World Bank, 2018).

alternatives like reusable pads, reusable menstrual underwear, and menstrual cups (Hennegan, 2019). Many of the reusable products have significantly lower life-cycle costs than disposable pads and are less vulnerable to supply-chain issues which makes them a more resilient and sustainable choice for the fight against period poverty. The need for resilience was brought to the forefront when several parts of the world experienced a 'sanitary pad crisis' during the COVID-19 lockdowns (Garikipati, 2020).

A broader concern is that public policy focus on access to pads, inadvertently, supports commercial interests that find it far more profitable to provide unbalanced marketing information about disposables, establishing these as the 'gold standard' (Bobel, 2019). It also fails to tackle cultural taboos that stigmatises menstruation, making it difficult for women to seek information on alternatives and their hygiene use. Informational asymmetries in the market, public policy and cultural taboos combined to increase the reliance on disposables the lack of informed choice potentially denies women access to their choice of menstrual materials that are safe, comfortable, and support sustainable production and consumption.

Systematic reviews of interventions using reusable products suggest that these are effective at providing hygienic menstrual protection comparable with single-use or disposable pads or tampons and are also largely acceptable by users (Hennegan and Montgomery 2019; van Ejik et al., 2019). These reviews highlight the heavy bias towards school-based interventions and the absence of quantitative empirical evaluations of community-level interventions. In particular, it remains unclear how interventions with informed choice and reusable alternatives will work in the community in settings where public policy has pushed for the use of disposable pads, commercial interests heavily promote disposables, and many people haven't been exposed to the full range of alternatives. Unless we know this, it is difficult to re-direct policy interventions aimed at alleviating period poverty.

These conditions are manifested in several developing countries and India is one such where the government has striven to improve access to sanitary pads via its national flagship program (Rashtriya Kishor Swasthya Kayakram – National Adolescent Health Program) and big pad manufacturers spend large amounts of money on marketing campaigns. Evidence suggests that these efforts have resulted in an increase in India's pad usage from up from 12% in 2010 (Plan India, 2012) to 36% by 2015-16 (National Family Health Survey, IIPS 2016). For those in the age group of 15-24, this figure is higher at 57.6%, with urban regions at 77.5% and rural at 48.2%. Despite the growing ubiquity of disposable pads, high costs and the need for periodic purchase means the incidence of period poverty continues to remain high.

In this paper, we explore how information on the full range of period products and access to reusable alternatives impacts menstrual practices and attitudes among women from low-income households in India. It is these households that have been the main recipients of government and NGO programs, but also where there is likely to be a high prevalence of period poverty. We report findings from a community-based intervention that randomly offered women either a reusable or a single-use period product and a comparable group is only given information on the full range of period products, including their hygienic use and disposal. We find that information and exposure to alternative products substantially increases preferences for these, especially for reusable products with lower life-cycle costs. Knowledge of menstrual hygiene also increased as did preference for sustainable waste management practices. Women offered single-use product are less likely to prefer reusable alternatives suggesting an 'invasive' disposable culture. As India is home to over 20% of world's menstruating girls and women (estimated from Census of India, 2011), with large gaps in period poverty among areas, there are substantial potential impacts from re-directing and expanding menstrual hygiene policy in India. More broadly, evaluation of this community-based intervention provides the first empirical view of the link between informed choice and menstrual outcomes, suggesting that its inclusion as a policy tool can effectively mitigate period poverty.

Our data is from a community-based intervention that was carried out in the city of Hyderabad, the capital of Telangana in South India. Community stakeholders and representatives worked with the research team in co-designing the intervention, including ethics and questionnaire design, but played no role in randomisation, intervention and data collection. The intervention was facilitated by an independent NGO (SAFA, India). A total of 500 women were enrolled, of which 277 completed the intervention.

In exploring the impact of a menstrual health initiatives, a community-based approach was considered critical because of the social stigma attached to menstruation. An intervention of this nature had to be relevant, but also culturally appropriate and acceptable to the community (Duncan and Kolt, 2019). This presented some challenges (discussed later), but it also improves the chances of replicability and relevance of our results to policy.

The key contribution of this research is to empirically evidence how women manage their periods in face of asymmetric information flows in the market and to test the viability of 'informed choice' as a policy instrument to sustainably alleviate period poverty in the Global South. Seminal research in this area suggests that information failure generally leads to sub-optimal decision-making or 'adverse-selection' by consumers (Akerlof 1970; Spence 2002).

In our work we find that information bias in the market that favors disposable pads compels consumers (and policy makers) to choose these. We argue that single-use or disposable pads are a sub-optimal choice because they present a bigger financial and ecological burden when compared to reusables (van Eijk et al. 2019; Borunda 2019) and are much more vulnerable to supply chain vagaries (Garikipati, 2020). In several cases we find that women sustain these choices despite serious hardships. We introduce the concept of 'perverse selection' to describe the tenacity of such choices that becomes embedded in consumer psyche as they relate product choices to their event experiences that are associated with emotional cues of shame and status which they refuse to alter even in face of adversities.

Studying women's menstrual product choices in an experimental setting enables us to discern the impact of information alone and in combination with exposure to 'new' reusable products. By examining women's menstrual product choices before and after the field trial we are also able to comment on the role of various factors, including institutional determinants like culture and policy. The findings of this research are of significance to the stakeholders in the menstrual hygiene product markets and public policy strategies in the Global South.

We begin by providing a brief history of menstrual products and the policy context in India. We then present our methods, followed by the results. Next, we discuss the results and their implications for policy. We conclude with reflections on next steps.

2. A brief history of menstrual products

For a large part of human history, menstruation was shrouded in traditions rooted in religious beliefs that considered period blood as 'dirty' and 'shameful' (Guterman, Mehta and Gibbs, 2007). Till the early 20th century, this narrative mired the development of menstrual products, reducing women to repurpose commonplace items like cloth and hay into menstrual absorbents (Strasser, 2014). It was only in 1921, when Kotex pads were first introduced into the American markets, that the era of modern period products began (Goldberg, 2016). From the start, marketing campaigns heavily leaned into the idea that using disposables freed women from the 'oppressive old ways', making them 'modern and efficient' (Vostral, 2018). The profit incentives were considerable as disposables locked women into a cycle of monthly purchases that lasted for several decades. Over the 1960s and 70s these products became more efficient as variants like tampons, winged-pads, plastic-backing and adhesive strips emerged. As more women entered the workforce, the appeal and ubiquity of disposables grew.

In mid-1980s, large pad companies recognized the vast potential for expansion into developing countries. Pads were more actively promoted over tampons because of the patriarchal taboos against vaginal insertion that prevailed across many cultures (Nappi, Liekens and Brandenburg, 2006). Increasing urban affluence and growing aspiration for comfort and convenience saw an increasing number of middle-class women in these countries take up disposable pads. Given the veritable vacuum of information around menstruation, it was easy for pad companies to position their product as the only means of hygienically managing periods.

Their efforts received a considerable boost in mid-2000s when global concerns around the menstrual health of girls and women from low-income households in developing countries started to take hold (Sommer et al. 2013). By 2015, several largescale public health campaigns were initiated to encourage women to transition away from the use of traditional cloth, which was considered unhygienic as its maintenance required adequate washing and direct sunlight drying. Public campaigns found it easier to piggyback on the marketing success of private companies that had already created mass awareness and aspiration for disposable pads. Access to disposable pads was considered as an adequate indicator of menstrual hygiene, with their free or heavily discounted distribution becoming the focus of government and third sector initiatives (Joshi, Buit and González-Botero, 2015; African Coalition for MHM, 2019). By promoting a single product category these initiatives inadvertently endorsed the prevailing public opinion that disposable pads provide the best menstrual protection. In just under 20 years, private companies and government initiatives transformed period product markets in developing countries, making disposable pads the most recognizable period product– although wide heterogeneity in usage is reported, even within the same country, with many millions of women still without access to any modern period product (Smith et al., 2020).

As disposables increased in popularity, concerns around their ecological sustainability has also grown (Elledge et al., 2018; Borunda, 2019). The global waste for pads alone is estimated at 480 billion soiled pads per year (van Ejik, 2019), majority of which reach landfills where the plastic polymers take years to decompose (Anmiya and Abhitha, 2021). Innovations in period products has kept pace with these concerns resulting in a range of options, several cheaper and greener than disposable pads. The most promising alternatives that have emerged are: menstrual cups; reusable cloth pads (including period pants) and compostable pads. Being ecologically more sustainable and lower life cycle costs makes some of these products a more viable option for tackling period poverty in the Global South. For instance, menstrual cups can last up to 10 years, and are estimated to have less

than 1.5% of the environmental impact of disposables at 10% of the cost (Hait and Powers, 2019).

Largescale trials also suggest that their adoption is likely to support menstrual health. A study from Uganda reports that schoolgirls using reusable pads report less difficulty and disgust with changing and cleaning absorbents and increased absorbent reliability (Hennegan et al., 2016). A study from western Kenya reports that the provision of menstrual cups (or disposable pads) reduces the exposure to sexual and reproductive harms among schoolgirls compared with usual practice (Benshaul-Tolonen et al., 2019). A meta-analysis that included 13 studies on menstrual cups reports that 73% (pooled estimate: n=1144; 95% CI 59–84, I=96%) of participants wished to continue use of the menstrual cup at study completion (van Eijk et al., 2019).

Although the market for these products is expanding, much of the growth has been in the west (echoing the initial phase for disposables). Despite their potential for alleviation of period poverty, information about these products is generally lacking in developing countries, both among consumers and policy makers (Hennegan, 2019). Private companies, motivated by profits and backed by large marketing budgets, were the harbingers of the 'sanitary pad revolution' in developing countries. Cloth period products that can potentially last for several years don't represent such profit margins. The informational asymmetries that favor disposables are unlikely to be set right via market forces alone. Publicly funded campaigns may be critical to tackle the informational deficit around reusable period products and their hygienic use. The evidence from this study will be useful in informing the design and scope of such policy.

3. The Policy Context in India

Home to over 20% of world's menstruating girls and women (Census of India, 2011), India represents an important case to study the impact of interventions on menstrual outcomes. Like in many developing countries, disposable sanitary pads have dominated India's menstrual landscape, especially over the last two decades. Sanitary pads were a niche product in India till as late as mid-1990s with two giant rivals, Proctor and Gamble and Johnson and Johnson, dominating the market. In 2012, a study by Plan India found that just 12% of India's 355 million menstruating age women used sanitary pads and 70% were unable to afford these.

Motivated by such reports, the government of India embarked on a series of interventions mainly focused on improving access to sanitary pads for girls and women from low-income households. Free or subsidized distribution of sanitary pads, mainly in schools, became one of

the core activities of government backed menstrual health initiatives. The largest such initiative was the distribution of pads via government schools as part of the nationwide Menstrual Hygiene Scheme of the Ministry of Health and Family Welfare launched in 2011 (Govt of India, 2019). In 2016, the management of the scheme was transferred from central to the state governments. The government also provided grants and subsidies for the creation of small-scale pad manufacturing units which offer the added advantage of livelihoods creation for women from low-income households (Venemae, 2014; Muralidharan, Patil and Patnaik, 2015), making the uptake of pads even more socially desirable.

Meanwhile, the market hegemony of the two big pad companies was being challenged by new entrants like Softy and Niine, which made pads a lot cheaper and accessible to a much wider clientele. Pads were also made available in small pack sizes to make it even more affordable and large network of pharmacies were used to reach every corner of the country (Garikipati, 2020).

In face of aspirational marketing by pad companies combined with state initiatives, menstrual health and hygiene in India have become synonymous with access to disposable pads. Data suggests that efforts to popularize disposable pads have resulted in a dramatic shift in menstrual practices across India within the short period of time, especially among young girls and urban populations. A systematic review of 138 studies, covering a pooled sample of 97,070 girls aged 10–19 years in India, found that commercial pad use had a prevalence of 67% in urban areas, and 32% in rural areas (van Eijk et al., 2016).

Despite these phenomenal increases in the use of sanitary pads in India, they remain out of reach for millions who live on relatively low-incomes. Even with a highly committed state apparatus, monthly purchase and distribution of sanitary pads represent a huge financial and logistical challenge. Although traditional cloth can be a hygienic menstrual absorbent, it requires correct usage and maintenance practices (Baker et al 2017; Torondel et al. 2018). Singular public policy focus on sanitary pads has sidestepped the need to break down cultural and knowledge barriers and improve access to wash facilities that inhibit women's ability to use cloth hygienically. Information asymmetries pose a significant hurdle to the challenge of achieving equity in the provision of menstrual hygiene for all in a context where illiteracy and poverty are widespread and taboos constraint women from seeking alternatives.

The precarity of sanitary waste disposal systems in India have also raised concern around the increasing reliance on sanitary pads (Elledge et al. 2018; Lopez, 2021). While efforts to improve awareness and popularize reusable alternatives in India lacks the backing of the state apparatus, there have been some local initiatives. For instance, the Alappuzha Municipality in

the state Kerala distributed 5000 menstrual cups to women on voluntary basis (Bechu 2019). Bobel et al (2021) and Mahajan (2019) discuss initiatives by NGOs, like WSSCC, SRF and AKDN, that have attempted to improve awareness of alternatives to single-use sanitary pads.

4. Methods

The analysis reported here uses data from a qualitative survey and community-based intervention with 277 women from ten locations in Hyderabad. The study design included repeat cross-sectional surveys over six months to quantify the effects of providing women with complete information about period products compared with combining knowledge provision with reusable cloth pad or single-use pads on women's preferences for menstrual materials and practices. Baseline was carried out from July to September 2017; interventions, including distribution of menstrual materials was completed by October 2017 and follow-up was from April to May 2018. This project was funded by a GCRF grant 2016/17 (Ref No. 141131). Ethics was approved and overseen by SAFA, India (Ref: Safa0317R) and the University of Liverpool, UK (Ref: RETH000734). Study protocol and methods were registered with The American Economic Association's registry for randomized controlled trials (RCT ID: AEARCTR-0008767).

4.1. Study objectives

This research examines a variety of questions related to women's menstrual beliefs, consumption behavior, and practices surrounding use and disposal. We use an experimental set up to explore the effects on these after exposure to three separate conditions: when women are offered complete information on the full range of menstrual alternatives (including their hygienic use and disposal); when they are offered reusable cloth-pads and information; and when they are offered disposable pads and information. In analyzing the findings, we explore several intersectional issues around women's menstrual preferences like: how do women with limited affordability weave in their aspirations to use a modern menstrual product with meagre family budgets? What other idiosyncratic and institutional determinants impact women's choice of period product, its use and disposal? Where do women acquire their knowledge of periods and products and how accurate is their information?

4.2. Study location and partner organisations

Field work was intended to be carried out in low-income settings of a large and growing urban city as we wanted to explore associated menstrual outcomes in challenging urban settings, like affordability, public policy penetration and disposal. The core research team had

previous experience with working in India, and had access to a wide-network of NGOs and research organisations across the country. Of these, SAFA and KGNMT were selected because of their strong community presence and extensive experience of working on community health issues, with demonstrable capacity to facilitate a community-based intervention. Additional information about these partner organisations and their role in the study is provided in Appendix A, Text Box A1. Partners jointly consulted to identify Hyderabad as the study areas and also identified ten study areas across the city to achieve a mix of geographical spread, access to amenities and other considerations like safety of enumerators and accessibility.

4.3. Participant selection, sampling and randomization

For each of the study areas, which were geographically large and spread-out, we used a combination of municipal voting list and local key informants, to generate a random sample of 50 households. From this list, we removed households that resided in the area only intermittently (*N=29*) and households that had no women in the age group 18-45 years of age (*N=18*). Using stratified random sampling, the remaining households were allocated to one of the three study conditions using the ratio of 4 women to product plus information condition for every 1 woman to the information only condition. No significant differences were found among conditions on location at the area level. The CONSORT diagram in Fig 1. depicts the flow diagram of the study, including enrolment and random allocation.

4.4. Interventions

All study participants received complete information on the full range of menstrual alternatives (except menstrual pants as these were not available to buy in India at the time of the intervention), along with their hygienic use, cost, access and correct disposal. For the two product conditions, participants also received sufficient menstrual products for slightly over six months. We wanted to trial at least one sustainable product against single-use pads to compare what impact exposure to sustainable alternatives has on women's preferences for period products. Lack of information on alternatives also made us want to compare product interventions against the impact of providing information only. To achieve community acceptance, the products used in the trial had to be selected carefully and with the involvement of the NGOs and community stakeholders. KGNMT facilitated this part of the study. A careful selection exercise was undertaken which assessed two products as viable for the community trial: a compostable single-use pad (Pad condition) and a reusable cloth-pad with an anti-microbial top layer (Cloth condition). The selection process and additional information about the products are detailed in Appendix A, Box A2.

The three study arms are: information + single-use pad (Pad condition); information + reusable cloth-pad (Cloth condition); and information only + usual practice (Inform-only condition). After allocation to study conditions, consent baseline was completed, and menstrual materials distributed to Pad and Cloth arms. SAFA facilitated data collection and interventions. All interactions were administered by two women: an employee of SAFA and a project enumerator.

4.5. Overview of study conditions

There were three study conditions: (1) Single-use arm provided with single-use pads and complete information on a range of menstrual alternatives; (2) Cloth arm was given cloth-pads and information on menstrual products; and (3) Inform-only arm, received information only. The current study analyses the time points directly before for all conditions (baseline), and after the women completed six months of product use (follow-up). Follow-up is used for comparisons between disposable pads to reusable cloth-pads to inform-only. Fig. 1 provides the study flow diagram, including the timing of the interventions and follow-up relevant to the analysis.

4.6. Data capture

Women participated in one-to-one interviews at household level that lasted approximately one hour each at baseline and at follow-up. We used structured questionnaires that were piloted beforehand during the planning phases to ensure that it was culturally appropriate and relevant to the purpose of this study. The baseline questionnaire generated socio-demographic and menstrual health related variables. At both baseline and follow-up, respondents were asked about their preferred menstrual product and their willingness to adopt alternative products and associated menstrual practices. We also included questions on current menstrual beliefs, awareness and disposal practices. There was also room for some open-ended answers which constitute the qualitative analysis. All measures used in this study are self-reported by respondents during interviews and have not been validated externally. Detailed information about the study measures is provided in Appendix A, Box A3.1 and A3.2.

4.6.1. Primary and secondary outcomes

The primary outcome is a measure of woman's preference for reusable/sustainable period products. It takes the value 1 if she chooses a sustainable product as the only choice or in combination with disposables received and 0 if she chooses disposable pads only (for details see Box A3.1). This outcome measure was chosen as the main objective of the study is to understand if knowledge of alternatives to pads and better access to at least some of these shifts women's menstrual preferences away from disposables. We also included three secondary

outcomes: a measure of their willingness to adopt sustainable menstrual practices in terms of use and disposal; a measure of their awareness of period products beyond traditional cloth and disposable pads; a measure of their beliefs about menstruation and menstrual products, including beliefs about the need for drying cloth in direct sunlight. These outcomes were chosen because in combination they encompassed attitudes towards menstrual materials and practices that are relatively more sustainable to use of disposable pads alone. Note that the outcomes of this study only measured change in beliefs, attitudes, knowledge and preferences, not actual behavioural change over a sustained period of time which is potentially more difficult to achieve, particularly in the context of developing countries (e.g., Paul-Ebhohimhen et al. 2008; Leventhal et al. 2016).

4.6.2. Covariates

We include a range of socio-demographic and menstrual hygiene related variables as covariates: age, marital status, education level, employment status, head of household, caste, access to private toilet (as a measure of household wealth) and menstrual product used at baseline (for details see Box A3.2).

4.7. Sample size

Stratified random sampling was used in this pilot to allocate eligible participants to one of the three study conditions: Pad (n = 200), Cloth (n = 200) and control Inform-only (n = 50). As the main aim of the study was to quantify the effects of exposure to reusable alternatives to single-use pads, the inform-only group was kept smaller than the arms providing products. Information on menstrual materials was provided to women across all three conditions. Sample size calculations assumed a 30% increase in preference for sustainable menstrual materials after exposure to these alternatives, requiring a total population of 386 (193 per arm), providing 85% power with 0.05 alpha.

4.8. Statistical methods

We begin by comparing the magnitude of difference between exposures to Cloth condition vs. the Pad condition by calculating the effect size using Cohen's term *d*. We also use Difference in Difference (DID) Binary Logistic (for primary outcome) and Ordinal Logistic (for secondary outcomes) Regression estimations and *F*-test for equality. In the case of secondary outcomes, we carry out the test of parallel lines to affirm that slope coefficients are the same across response categories. For each case, we began by conducting DID regressions for the outcome variables with and without covariates. We then examined the Nagelkerke R^2 values to choose the models with the best-fit that explained the largest amount of variance for

interpretation and further analysis. In each case, we found that the models with covariates explained more of the variance in the data and provided a better fit.

We investigated the magnitude, direction and significance of the effects for all outcomes from the best-fit models that include covariates to evaluate the effectiveness of non-Pad conditions (Cloth and Inform-only) versus Pad condition. We consider each of the conditions separately and present these as our main results. We then test the robustness of our results in two ways. First, we combined the Cloth and Inform-only conditions given that the mean of the outcomes across these are not significantly different. This also aligns with our objective, to understand if how women's preferences shift after exposure to information about alternatives to single-use pads or after access to alternatives. The results remain robust across the two specifications and are presented in Table B2, Appendix B. Given this, we examined the magnitude and direction of the coefficients for the non-disposable interventions × time interactions (follow-up), which, combined with *F*-test, allowed us to compare the effects of each intervention against another. Second, in the case of secondary outcomes, we carry out Multinomial-Logit Regression estimations to check for the robustness of our results. These are available upon request.

All analyses were intent-to-treat, meaning that all women randomized into a study condition were analyzed as part of that condition, regardless of whether or not they used the menstrual product they were given as part of their intervention condition.

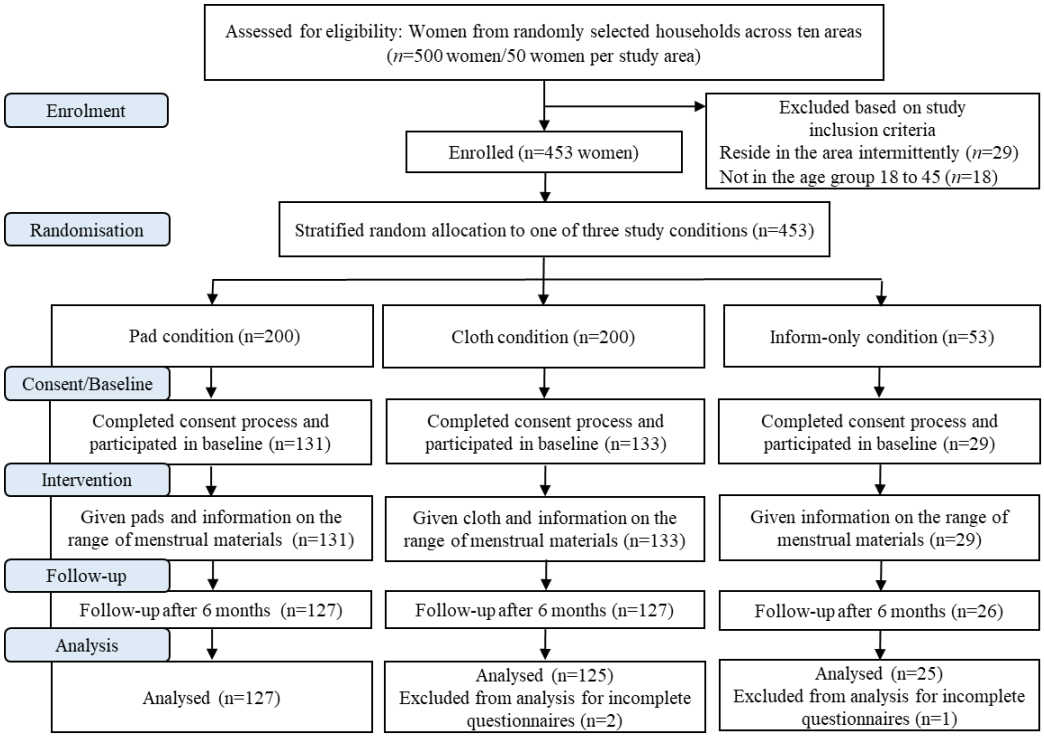

Fig. 1. CONSORT diagram detailing study flow of all relevant aspects and conditions.

5. Results

5.1. ***Study flow and follow-up attrition***

Fig. 1 illustrates the flow diagram for the study. Of the 453 women enrolled, 293 (64.67%) completed the consent process and baseline. This was mainly owing to the sensitive nature of the research topic but also due to other reasons like availability and lack of private space. Of these, 277 (95.56%) were evaluated at six months follow-up. We found no significant difference on the proportion of women evaluated by condition. Of the 131 women consenting to participate and allocated to the Pad condition, 127 (96.95%) completed the six months follow-up. Cloth condition also included 127 at follow up of the 133 who consented (95.49%) and Inform-only included 26 of 29 who consented (89.65%). At analysis, three interviews were excluded as they were incomplete owing to women leaving interviews mid-way for various reasons not connected to the study. Women lost to follow-up and analysis did not differ significantly on covariates or outcomes as measured at baseline.

5.2. ***Covariates and outcomes at baseline***

Table 1 provides baseline scores for covariates and outcomes, including women's socio-demographic characteristics for all who completed baseline (N = 293). At baseline, women in the full sample were an average of 28 years old (SD = 7.53). Most had some education, with a mean score of 1.58, indicating high school attendance on average (SD = 1.14). Approximately 20% were in paid employment (SD = 41%) and lived in households typically headed by their husbands or parents with average score of 1.12 (SD = 0.68). This is double the average urban employment rate for women in India which was around 9.7% during the study period (Centre for Monitoring Indian Economy, 2019). Seventeen percent were from backward castes, which is likely to have complex intersectional implications for women's agency, holding them back socially and economically but also giving them greater autonomy and mobility outside their homes (SD = 0.54). Sixty percent of women had access to a private toilet (SD = 49%) while remaining used communal facilities. Lack of access to private toilets suggests that ~40% of study participants were from relatively low-income households. At baseline, around 78% women stated using disposable pads as their only or main menstrual protection (SD = 42%). Few cloth users innately preferred using cloth, most did so due to reasons of affordability. Cloth users were all over 40 years of age, suggesting that this practice is dying out. Many were mothers to daughters who used pads.

Levene's F-test for equality of variance is used to check for the effectiveness of the randomization strategy. We found differences across conditions only on the covariate that

measured head of household, suggesting that women with greater decision-making agency are somewhat over represented in the Cloth condition than Pad condition (but not Inform-only).

With respect to outcomes, the only difference we found at baseline is that women in the Inform-only group are more willing to adapt menstrual practices than the two product arms. Two further results on outcomes at baseline are worth noting. First, we found that awareness of menstrual materials other than cloth and disposable pads was negligible among women. Twenty-six research participants (9.75%) knew that sanitary pads could be made of compostable materials (cotton, banana pulp etc.), but none of them had heard of menstrual cups, commercially made reusable cloth-pads, or tampons. Second, we found that women's beliefs on menstruation and menstrual materials at baseline reflected cultural taboos and misinformation. The mean score on beliefs was 1.36 of a possible 3, meaning more than half of what women knew or believed about menstruation and period products was inaccurate. Women from lower-caste households were less likely to follow cultural norms that constrain their mobility during menstruation. This may be because these women are less able to afford such restrictions on their mobility.

Evidence from qualitative interviews suggests that gaps in knowledge and information may be driven at fundamental levels by existing social norms which contribute to a culture of shame and silence around menstruation, hindering women from talking about it openly or seeking information. Women in the study frequently used words like "*galeez*" (impure) and "*sharmanak*" (shameful) to describe their lived experiences with menstruation. Exposure to urban living and education seem to have little impact on these attitudes. None of the women participants had learnt about menstrual hygiene management at school or college, leaving them to rely either on product advertisements or on their closest female networks. This created a bias in favor of pads and increased the circulation of misinformation about other products, even among relatively better educated women. A 23-year-old respondent, who had completed college education, claimed that she knew cloth was inferior to disposable pads because "*My aunt told us that her friend became infertile because of using cloth*".

The emotions of shame and embarrassment have led to unhygienic and unsustainable menstrual practices. Women were expected to hide their periods from the men in the household, so drying washed cloth openly under direct sunlight was frowned upon. Around half the study participants who used cloth, reported drying cloth indoors, sometimes hidden under a mattress or inside a closed cupboard. This was considered as the "*saahi*" (correct / respectful) thing to do. Women also adopted disposal practices that would allow them to "hide their shame" from the men. We found that many young girls simply threw used pads into the stream that flowed

next to their homes. Participants in their late twenties told us: "*We have a huge river behind us, the pad will just flow away with it"; "I wrap it [used pad] in a plastic bag, before throwing it in the river, how can I throw it just like that?"*

Survey data suggests that commercial adverts and public hygiene campaigns have had a significant influence on knowledge, tastes and preference. All research participants had seen several adverts or public health messages for disposable sanitary pads, but none had seen one for any other product. Government sponsored promotion of pads are regularly played on radio, TV and in cinemas. Younger women (ages 19 to 26) tended to described preference for pads using aspirational language cues like *"it is modern"*, *"I am a city girl"* and *"pad is costly, but pad is best"*, associating pad usage with status. In stark contrast, using cloth was perceived as "*stepping into the dark ages"*. One young girl (who states her mother as a cloth-user), expressed the view that *"…I can go without eating, but I cannot go without pads"* (age, 19).

5.3. Analyzing product interventions

Table 2 provides follow-up scores on how women responded to the product conditions. While all the participants used the distributed products, approximately 38% (n = 48) in Pad arm and 21% (n = 26) in the Cloth arm used it in combination with their usual menstrual protection. We found significant differences across conditions on responses measuring perceptions of distributed products. Perception of convenience to use and comfort were better in the Pad arm, whereas the Cloth arm scored better on reducing menstrual waste.

5.4. Analyzing outcomes

Table 3 presents that post-intervention scores on the primary and secondary outcomes across conditions and the effect size of Cloth condition vs. Pad condition for all outcomes. We found differences across conditions on all the outcomes at follow-up, suggesting that study conditions worked as intended. Significantly, women in sustainable conditions (both Cloth and Inform-only) were more likely to express a preference for reusable menstrual materials (Cohen's d: 0.45, p = 0.003) and were more willing to adapt associated menstrual practices at follow-up (Cohen's d: 0.39, p = 0.021) than women in Pad condition.

Further, we conduct the DID regression analysis and examination of pseudo-Nagelkerke R^2 values indicated that in all the cases, the model including study covariates explained more of the variance in the data than the model without covariates. Hence, for the remaining of the analyses, we use models that included covariates for all primary and secondary outcomes. Full regressions models, including results on covariates, are presented in Appendix B, Table B1.

Table 4 presents the relevant summary effect sizes when adjusted for covariates, i.e., DID coefficient and significance level for each of the sustainable intervention's effect versus Pad,

which is the coefficient of the intervention × time interactions from the regression models. We also present comparisons with significance levels among effect sizes from F-tests for equality.

There was clear support to suggest that exposure to both the Cloth condition as well as the Inform-only condition have a positive influence on women's preference for reusable menstrual products that were so far unknown to them (Exp(β): 2.37, p = 0.037 and Exp(β): 3.74, p = 0.044 respectively). The result is robust to combining the two conditions and comparing with Pad condition (Exp(β): 2.560, p = 0.018). Significantly, these results alongside participant testimonials suggest that despite the taboos associated with vaginal insertion, they are willing to trial products like menstrual cups. Exemplifying this attitude was the statement by one of them who told us, "*I feel I could use a menstrual cup. Why no one told us before now?"* (age 38). Women also gave suggestions on how information could be shared: *Someone should tell us no? Such group discussions, teachers, government … they can put posters."* (age 34)

Results on secondary outcomes further support the primary outcome, but most are not statistically significant. Cloth condition had a positive influence on women's willingness to adapt sustainable menstrual practices (β: 0.621, p = 0.089) and that this result remains robust when combined with Inform-only group (β: 0.588, p = 0.083). With respect to other secondary outcomes, we found no difference across conditions with respect to awareness of alternative menstrual absorbents and on women's beliefs about menstruation. Overall, while awareness of alternatives improved from baseline (for most women by 2 points), beliefs about menstruation were much more difficult to shift (not changing for half the respondents).

Table 1.
Baseline scores on covariates and outcome and analysis of variance among conditions

Study variable	Scores for the full sample and intervention conditions				ANOVA
	Full sample	Pad	Cloth	Inform-only	*P*-value
Covariates					
Age (*years*)	28.01 (7.53)	28.39[a] (6.92)	27.94[a] (8.09)	26.48[a] (7.70)	0.505
Education level	1.58 (1.14)	1.56[a] (1.04)	1.62[a] (1.20)	1.52[a] (1.39)	0.865
Employed	0.21 (0.41)	0.20[a] (0.40)	0.22[a] (0.41)	0.28[a] (0.46)	0.649
Head of household	1.13 (0.68)	1.04[a] (0.62)	1.22[b] (0.75)	1.12[ab] (0.60)	0.121
Backward caste	0.17 (0.54)	0.18[a] (0.68)	0.14[a] (0.34)	0.32[b] (0.48)	0.289
Private toilet	0.60 (0.49)	0.65[a] (0.48)	0.58[a] (0.50)	0.52[a] (0.51)	0.359
Pad users[+]	0.78 (0.41)	0.78[a] (0.42)	0.77[a] (0.42)	0.84[a] (0.37)	0.732
Primary outcome					
Preference for sustainable materials	0.28 (0.45)	0.28[a] (0.45)	0.29[a] (0.46)	0.24[a] (0.44)	0.885
Secondary outcomes					
Willing to adapt menstrual practices	0.55 (0.50)	0.53[a] (0.50)	0.54[a] (0.50)	0.76[b] (0.44)	0.091
Awareness of alternatives	0.09 (0.29)	0.08[a] (0.27)	0.10[a] (0.31)	0.12[a] (0.33)	0.709
Beliefs about periods & products	1.36 (0.66)	1.40[a] (0.70)	1.34[a] (0.63)	1.24[a] (0.64)	0.470
Number of observations	293	131	133	29	

Note. Scores are presented as Mean (Standard Deviation). Number of observations are given in the last row.
Abbreviations. ANOVA = Analysis of variance.

[a,b] Values with the same superscripts in the same row are not significantly different at p ≤ 0.05 for ANOVA and post-hoc tests; different superscripts indicate that the Means are significantly different.
[+] 64.26% (*n* = 178) study participants report using disposable pads only; 13.72% (*n* = 38) report using disposable pads mainly but also cloth and 22.02% (*n* = 61) report using cloth only. All disposable pad users have been combined.

Table 2
Scores on use and perception of products distributed in the product conditions (PI and CI).

Variable of interest	Pad	Cloth	*t*-test
Used the product distributed	0.98 (0.13)	1.00 (0.00)	1.409
Used in combination with other menstrual materials	0.38 (0.49)	0.21 (0.41)	-3.007**
Convenience and comfort of use	0.86 (0.35)	0.54 (0.50)	-5.912***
Helps reduce menstrual waste	0.36 (0.48)	0.62 (0.49)	4.150***
Number of observations	127	125	

Notes. Scores are presented as Mean (Standard Deviation).
Inference. * Indicates difference between Means is significant at 0.10 level, ** at 0.05 level and *** at 0.01 level.

Table 3
Follow-up scores on outcomes, post-hoc difference tests and effect size (Cloth and Inform-only vs. Pad condition).

Study variable	Scores for the full sample and intervention conditions				Cohen's *d**	*p*-value term
	All	Pad	Cloth	Inform		
Primary outcomes						
Prefer sustainable materials	0.42 (0.49)	0.31[a] (0.47)	0.50[b] (0.50)	0.56[b] (0.51)	0.45	0.003
Secondary outcomes						
Willing to adapt menstrual practices	0.96 (0.67)	0.85[a] (0.66)	1.02[b] (0.68)	1.20[b] (0.64)	0.39	0.021
Awareness of alternatives	1.26 (0.58)	1.22[a] (0.52)	1.30[a] (0.65)	1.32[a] (0.56)	0.16	0.520
Beliefs about periods & products	2.19 (0.62)	2.13[a] (0.67)	2.26[b] (0.57)	2.20[ab] (0.58)	0.16	0.246
Number of observations	277	127	125	25		

Note. Scores are presented as Mean (Standard Deviation). Number of observations are given in the last row.
* Effect sizes (unadjusted for covariates) are computed using Cohen's term *d* (Carson 2012).
[a,b] Values with the same superscripts in each row are not significantly different at $p \leq 0.05$ for ANOVA and post-hoc tests; different superscripts indicate that the Means are significantly different.

Table 4.
Summary of Difference-in-Difference coefficients for Cloth and Inform-only vs. Pad condition (coefficients of the intervention × time interaction variable) and F-tests for equality among interventions.

	Intervention conditions		
	Cloth	Inform-only	Cloth + Inform-only
Primary outcomes			
Preference for sustainable materials	2.369[a]**	3.737[b]**	2.560[ab]**
Secondary outcomes			
Willing to adapt menstrual practices	0.621[a]*	0.421	0.588[a]*
Awareness of alternatives	0.077	0.286	0.002
Beliefs about periods & products	0.537[a]*	0.645	0.556[a]*

Note. Positive coefficients indicate that the intervention was more effective compared to the condition in which pads and information were offered to women
a,b,c Values with the same superscripts in each row do not differ at p 0.025 (primary outcomes) or p 0.05 (secondary outcomes); values with different superscripts differ significantly.
For all outcomes: ** $p \leq 0.05$, * $p \leq 0.10$

6. Discussion

What do these findings imply for menstrual health policy in India and other developing countries, especially in terms of the prognosis for introducing reusable menstrual products amongst its urban populace as a way of furthering period equity? This question is even more relevant now after COVID-19 exposed the vulnerabilities of global supply chains, with shortages in sanitary pad supplies emerging as a particular concern in many parts of the world.

The main observation at baseline is that disposable pads are now the main period product in urban areas, even amongst low-income households. Nearly 78% of research participants report using disposable pads either as the only protection or main menstrual protection. This is comparable with estimates from the National Family Health Survey (IIPS 2016). Most users of traditional cloth did so due to lack of affordability rather than innate preference.

Respondents associated menstruation with emotional cues of 'shame' and 'stigma' and were keen to hide this bodily function from others, especially men. Such attitudes of 'stigmatization' are rather widespread across the context of both developing (Garikipati and Boudot 2017; Hennegan et al., 2019; Sivakami et al. 2019) and developed countries (Seear, 2009; Boyers et al., 2022). Period 'shame' was further manifested in stigmatizing the use of traditional cloth which required washing and open sunlight drying. This in turn made women value disposable pads as a product that could be conveniently used and discarded, thus efficiently saving them from the 'humiliation' of having periods. State funding campaigns for the popularization of disposable pads have inadvertently fueled these perceptions. Studying menstrual practices among wealthier women in India, Meenakshi (2020) finds that even though wealthier women have a desire to make environmentally friendly choices, strong taboo prevents them from transitioning to reusable sanitary protection.

Younger women in our study were even prepared to sacrifice essential consumption to continue using disposable pads. For low-income households, buying disposable pads every month represented a considerable commitment and, in some instances, required real sacrifices. Some older women went without pads to ensure that their daughters could continue using these. For many younger women using disposable pads was a symbol of 'modernity' and of 'being from the city'; not simply a matter of convenience and habit but something that defined their 'identity' and 'status' that they could not do without, even if meant sacrifices elsewhere. Similar instances have been reported from other developing countries, like from rural Kenya,

where, in extreme cases, school girls are reported to have provided sexual favors in exchange for disposable pads (Oruko et al., 2015).

Cultural taboos also meant that formal education or other sources of information had little role to play in what women knew about menstruation. Women's knowledge about menstruation was influenced by commercial adverts and anecdotal exchanges with their close social circles. Similar findings are reported for Scottish women by Santer, Wyke and Warner (2018). Significantly, we found that respondents had little knowledge of reusable alternatives like menstrual cups or commercial cloth-pads that are easier to wash and dry and have the potential to support menstrual hygiene at much lower cost over product lifetime. Commercial advertisement that popularized disposable pads have taken over the period product space that is difficult to infiltrate for producers of reusables that have much smaller profit margins. Adding to this unbalanced marketing information, public health messaging on menstrual hygiene also promoted disposable pads.

Given the lack of information on other viable period products, it is unsurprising that women have little choice but to select sanitary pads. This is the classic case of adverse-selection in the presence of asymmetric information; and one can expect that correcting for biases in information flow should help widen selection. Our post-intervention results suggest that this may happen to some extent. Exposing consumers to information on the full range of period products and giving them an opportunity to trial these has the potential to reverse consumer's adverse-selection and steer the period products markets towards sustainability, both for consumer costs and their environs. Informing women of various alternatives is likely to influence their choices to a similar extent as providing them with sustainable alternatives to disposable pads. While women from Inform-only condition were somewhat more willing to experiment with period products than other conditions at baseline, women in the Cloth and Inform-only groups exhibited similar preferences at follow-up.

Results on secondary outcome regarding willingness to adapt menstrual practices follow a similar trend, in that women in the Cloth and Inform-only conditions were seen to be more willing to trial reusables products and sustainable waste management practices than Pad condition. Results also show that women's knowledge of alternative materials improved across all conditions by an average of two points, suggesting there are substantial gains to be had from providing information on alternative period products to women in its own right. The final secondary outcome – beliefs regarding menstrual materials – was the most difficult to change from baseline. Across South Asia, menstruation invokes strong cultural taboos, where restrictions are placed on menstruating girls and women, including separation of touching,

eating, drinking and sharing facilities (Garikipati and Boudot 2017; Sivakami et al. 2019). The information provided by the study seems to have had little impact on these beliefs. A study by van Eijk et al. (2016) also finds that despite an increase in education, knowledge of menstrual health in general and among women has remained low with no evidence of change in the past two decades. Notably, despite being given the same information, women in the Pad condition were significantly more likely to hold the belief that disposable pad is superior to other period products. Offering women disposable pads may have simply reinforced their original belief that *'pad is best'* causing them to ignore the information given about alternative menstrual materials, as also reflected in their preferences at follow-up.

Taken together, our results suggest that women have developed a 'relational bond' with disposable pads that are grounded in cultural, emotional and habitual cues. This has semblances with Fournier's (1998) relationship theory, which proposes that consumers form relationships with products that conform to their contextual values and beliefs. The choice of pad may be an initial response to emotional cues of shame and status, but the cultural roots of their inclinations became tenacious and embedded in their consumer psyche via commercial and state campaigns that popularized a single product category. This relational bond may be stronger among younger women who have had no exposure to alternatives and are hence prepared to face serious hardships to be able to continue using pads.

These results indicate a serious market and public policy failure in bringing to consumer's attention the full range of menstrual products, so they have a wider product base from which to make an informed choice. Policy focus on disposable pads alone denies menstruators access to information on alternative menstrual absorbents, essentially impeding their ability to choose effectually. There is an urgent need that the menstrual health policy in India and in other developing countries moves beyond promoting and subsidizing disposable pads and recognizes the need for informed choice. Informed choice should not only include awareness on the full range of menstrual materials available but also on educating girls and women on their hygienic use and appropriate disposal. For instance, one of the issues with cloth usage has been not drying it in direct sun light, which is likely to render it unhygienic. Much of the perceived inferiority of cloth is likely to be related to its improper usage (Baker et al 2017; Torondel et al., 2018). Informing women's choice of menstrual material is not only likely to uphold their right to informed choice but also reduce the financial and environmental burden of menstrual management.

6.1. Limitations

This study has two main limitations: first, the follow-up sample sizes are small, especially for the Inform-only condition and second, the challenges of conducting menstrual product interventions in India have meant compromising on the variety of period products that could be meet with community approval for use in the field experiment.

6.1.1. Sample size

The final sample analyzed in the three study conditions were: Pad (n = 127); Cloth (n = 125) and Inform-only (n = 25). Post-hoc sample size calculations suggest that for an increase of 53% in preference for sustainable menstrual materials after exposure to alternatives to disposable pad, i.e., from 51% in the Pad condition to 78% in the Cloth condition, the sample provides 99.6% power with 0.05 alpha. Similarly, we can draw comparisons between Pad and Inform-only groups with 100% power and 0.05 alpha. However, when comparing Cloth and Inform-only conditions, the actual power is just 58.5%, mainly because these two groups have similar post-intervention results (and distinct to the Disposable group). This means caution is necessary when comparing these two groups.

6.1.2. Challenges of conducting menstrual product interventions in India

The study was originally planned to introduce menstrual cups as one of the period products in the field. However, menstrual cups were met with considerable opposition from local IRB and from partner organizations and community-leaders due to the requirement for vaginal insertion. After considered deliberations, the study design was altered to include only non-insertion menstrual products. This not only delayed the study which had cascading implications on project timeline and budget but also limited its scope. Study was also delayed at baseline due to the time spent in obtaining consent from participants because of the sensitivity around the research topic. These delays also hindered the ability to make multiple visits to recruit all the women enrolled. This experience suggests that public policy efforts around normalizing menstruation are in dire need in India and comparable countries.

7. Concluding Comments

The last 15 years have been an exciting time for innovations in period products, where new and reusable innovations have continued to emerge. Some of these products have the potential to end period poverty more equitably and sustainably than disposables. The findings of this study identify that information about these products, however, has not cascaded down to consumers

and policy makers, especially in developing countries where openly talking about menstruation remains a taboo and the only information on period products comes from private advertising that is dominated by the manufacturers of disposable pads. In this backdrop, policy makers also continue to back public interventions that promote disposable pads. None of the respondents in our study were even aware of reusable alternatives to disposable pads. *This indicates a serious public policy failure that effectively denies women the right to informed choice.* In this backdrop, the preference for disposable pads has emerged as an adverse selection where consumers are forced into selecting just this one product type with frequently aberrant consequences for family budgets and for their ecosystems. Lack of correct and complete information on alternative period products has also led to market failure where the market has failed to respond to the latent needs of consumers for low cost and environmentally friendly products.

Despite the general caution attached to studies with small sample sizes, our results suggest that as a policy tool, informed choice has the potential to reverse this adverse selection and steer the period product market in a sustainable direction, both for consumer costs and their environs. If given comprehensive information on all available menstrual products, women are likely to make a choice that considers not only costs to themselves and their health but also costs to the environment. Increase in demand for a range of products, including reusable alternatives, is likely to incentivise the markets into improving availability and access to these. The results, however, also suggest that women value the convenience of using and throwing disposable pads and any serious efforts to promote reusable menstrual products will require innovations focused on convenience to end-users.

Wider product choice is likely to support menstrual hygiene management even amongst low-income households, while giving consumers the agency to effectually manage their menstrual needs. Breaking down the cultural taboos and silence around menstruation is a likely prerequisite to ensure that full and correct information on menstrual alternatives can reach women, suggesting that a variety of stakeholders will need to participate in this process to bring down the veil of misinformation – including women's close social contacts (mothers, family members and community influencers), health care providers (frontline workers, community frontline workers and health care professionals) and government programmes (use of promotional advertising and tangible interventions like product distribution).

Given serious market failure and the economic imbalances between producers of various period products, it is likely that we will require policy-driven messaging, at the minimum to support awareness of alternative choices, but where possible to also include proactive subsidy

and promotion of reusable alternatives. This can also enable developing countries overcome period poverty in a way that is equitable and resilient such that the ultimate goal of 'period equity' can be realized – where every woman, irrespective of her socio-economic background, has the agency to hygienically and sustainably manage her periods.

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Appendices

Appendix A: Detailing Estimates, Methods and Measurement

Text Box A1

Facilitating NGOs

- Safa, India <http://www.safaindia.org/> is a NGO, mainly working with women from low-income households belonging to ethnic minority communities in and around Hyderabad. It focuses on education and income generation activities as it considers these the ultimate drivers of socioeconomic empowerment. Safa provides its women members with livelihood trainings such as tailoring and embroidery, as well as entrepreneurship opportunities through the sales of its members' handmade products including bags, soft toys, carpets and others. Safa supported the planning phases, ethics, pilot and facilitated the interventions.

- KGNMT (Kasturba Gandhi National Memorial Trust) <http://kgnmthyd.org/> is a national NGO, with 23 branches all over the country. While their mission is to improve the lives of the country's most needy women and children, each branch has some autonomy in deciding their specific remit. Its branch in Hyderabad provides residential and livelihood support to women who have been victims of crimes like trafficking and domestic violence and supports the socioeconomic empowerment of women living in the community. KGNMT supported the planning phases, in selection of period products for the interventions and in data gathering.

Text Box A2

Community-led selection of the period products used in the study interventions

Selection Process: We began by consulting NGO partners, representatives from the communities where NGO partners were active and representatives from local organisations working in menstrual hygiene. It became evident quite early in our discussions that products that required insertion (mainly menstrual cups) would not gain community acceptance. SAFA's IRB raised concerns about this as well. Following considered deliberations with all stakeholders (a total of 3 meetings), we excluded products that required vaginal insertion. Further, given that the project was about sustainable period products and was based in India, we decided to include only sustainable products that were available in India. Using this as a starting, we developed a long-list of 15 menstrual products that could be trialed in the community. On voluntary basis, ten women residing at KGNMT, who were not part of the final study, were recruited to trial the products. Each volunteer was given three products to sample. After the completion of at one full menstrual cycle, they were asked to rank each product on three measures:

1. "How comfortable is it to wear?"
2. "How convenient is it to change?"
3. "How well does it wash? OR How easy is it to follow the manufacturer recommended decomposing procedure?

To better understand the ranking, we also carried out informal discussions with the women. The results of this exercise were presented at a project meeting on 11th April, 2017 in Hyderabad, with representatives from partner NGO and local organisation were present and where the final selection was made consensually.

The following products were selected for distribution in the two product conditions:

1. Anandi pad, manufactured by Akkar Innovations <https://aakarinnovations.com/anandi/> was selected for the Pad condition. Anandi pad is averred to be India's first disposable 100% biodegradable pads that disintegrates into natural elements in a compost environment in 90 to 180 days depending on environmental considerations.

2. Safepad, a reusable cloth pad manufactured by RealRelief <http://www.realreliefway.com/en-us/life-saving-products/health/safepad™/safepad™> was selected for the Cloth condition. Safepad is understood to be designed with a permanently bonded antimicrobial technology that helps reduce vaginal infections caused by Candida albicans and other pathogens.

Text Box A3.1

Measurement details for outcome variables

Primary Outcome: Preference for menstrual materials

1. Preference for sustainable menstrual absorbents: A measure for women's preference for sustainable materials was developed using their response to the following question: "Can you please tell us what menstrual material you prefer most? In answering this question, please think only of your preference and not of other factors like price and availability. You can choose a single menstrual material you prefer, or if you like, you can choose a combination of materials you prefer". Women who chose a reusable/ sustainable product (homemade cloth-pad; commercial cloth-pad; menstrual cup; compostable pad) either as their only choice or in combination with disposables took value one, and those who chose disposable pads only took value zero.

Secondary Outcomes: Attitude to change, awareness and beliefs

1. Willing to adapt menstrual practices: This measures women's willingness to adopt sustainable practices in two areas: use and waste management. Responses were noted on three questions:
- "Would you be willing to try a new sustainable menstrual product?"
- "Would you be willing to pay for the safe waste disposal of your menstrual absorbent?"
- "Would you be willing to dig a pit for burial of compostable menstrual product?"

A woman received one point if she answered "yes" to the use question and one point for answering "yes" to either of the disposal questions. Thus, the willingness to adapt score ranges from 0-2, with higher score indicating greater willingness to adapt practices.

2. Aware of alternatives to cloth and pad: This measures women's awareness of the range of menstrual materials beyond traditional cloth and disposable pad. Women were asked to name or describe all the menstrual material they were aware of. For each menstrual material they named or described other than traditional cloth or disposable pad they were given one point. The knowledge of menstrual products scores ranges from 0 to 4, with higher scores indicating greater knowledge of menstrual materials beyond cloth and pad.

3. Beliefs about periods & products: Beliefs about menstruation and menstrual products is measured using the responses women gave to three questions:
- "Should girls and women continue with their normal activities during their menses?"
- "Does menstrual cloth need direct sunlight drying after wash?"
- "If correctly used, can cloth provide equally good menstrual protection as a disposable pad?"

A woman received one point for each question she answered "yes". Thus, the possible range of scores are 0-3, with higher score indicating more accurate beliefs about menstruation and period materials.

Text Box A3.2

Measurement details for covariates

Covariates:

1. Age: Age is measured in the number of years completed

2. Education level: Women were asked about their level of education and this was later divided into five categories: no education; completed secondary school; did not complete high school; completed high school; college; graduate. Education scores range from 0 to 5, with greater score indicating higher education level.

3. Employed: This variable indicates woman's employment status. This covariate is dichotomous, with 1 indicating that she is employed and 0 indicating that she isn't.

4. Head of household: Women were asked about who headed their household. This variable is scored based on the assumption that woman's ability to bargain for a specific outcome is likely to be influenced by who heads the households in the following ascending order: in-laws other than husband; husband; parents and self. Thus, head of household scores range from 0 to 3, with greater scores indicating greater bargaining power.

5. Backward caste: This variable indicates social status of woman's household. This is a dichotomous covariate, with 1 indicating that the household belongs to a backward caste and 0 indicating that it does not.

6. Private toilet: This variable indicates whether the woman has access to a private toilet. A dichotomous covariate, with 1 indicating that she has access to a private toilet and 0 indicating that she does not.

7. Pad users: Women were asked what menstrual material they used. This covariate is dichotomous, with 1 indicating that she used pad either as the main protection or in combination with cloth and 0 indicated she used cloth only.

Appendix B: Supplementary Results Tables

Table B1.
Difference-in-Difference Binary Logistic (primary outcome) and Ordinal Logistic (secondary outcomes) Regression Results Including Covariates (Cloth and Inform-only vs. Pad)

	Primary outcome	Secondary outcomes		
	Preference for sustainable materials	Willingness to adapt menstrual practices	Awareness of alternatives to cloth and pad	Beliefs about menstrual materials
Cloth	1.048	0.112	0.204	-0.125
	(0.304)	(0.257)	(0.452)	(0.260)
Inform-only	1.061	0.953**	0.318	-0.268
	(0.541)	(0.451)	(0.721)	(0.458)
Time	1.244	1.108***	8.424***	2.525***
	(0.296)	(0.261)	(1.079)	(0.280)
Cloth × Time	2.369**	0.621*	-0.077	0.537
	(0.414)	(0.366)	(0.556)	(0.364)
Inform-only × Time	3.737**	0.421	0.286	0.645
	(0.610)	(0.630)	(0.878)	(0.635)
Age (years)	1.023*	0.031***	0.029*	0.046***
	(0.014)	(0.012)	(0.016)	(0.012)
Education level	1.099	0.018	0.239**	0.048
	(0.094)	(0.083)	(0.118)	(0.083)
Employed	0.741	-0.387*	-0.073	-0.490*
	(0.261)	(0.230)	(0.333)	(0.229)
Head of household	0.962	-0.188	0.548***	0.021
	(0.149)	(0.136)	(0.198)	(0.134)
Backward caste	0.838	-0.217	0.234	0.526**
	(0.177)	(0.188)	(0.246)	(0.183)
Private toilet	1.128	0.075	0.204	0.478
	(0.216)	(0.188)	(0.452)	(0.192)
Pad users	0.139***	1.052***	1.723***	-1.557
	(0.269)	(0.243)	(0.453)	(.242)
Observations	554	554	554	554
Log Likelihood	621.149	883.223	489.987	941.835
Nagelkerke R^2	0.220	0.221	0.776	0.444

Note. Standard errors in parentheses.
Abbreviations. ANOVA = Analysis of variance. PI = Pad and Information. CI = Cloth and Information. OI = Only Information.
*** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$

Table B2.
Difference-in-Difference Binary Logistic (primary outcome) and Ordinal Logistic (secondary outcomes) Regression Results Including Covariates (Cloth + Inform-only vs. Pad)

	Primary outcome	Secondary outcomes		
	Preference for sustainable materials	Willingness to adapt menstrual practices	Awareness of alternatives to cloth and pad	Beliefs about menstrual materials
Cloth + Inform-only	1.050	0.253	0.225	-0.150
	(0.292)	(0.246)	(0.433)	(0.249)
Time	1.244	1.100***	8.406***	2.524***
	(0.296)	(0.260)	(1.077)	(0.280)
Cloth + Inform-only × Time	2.560**	0.588*	-0.002	0.556
	(0.397)	(0.350)	(0.530)	(0.349)
Age (years)	1.023	0.029**	0.028*	0.047***
	(0.014)	(0.012)	(0.016)	(0.012)
Education level	1.097	0.008	0.244**	0.049
	(0.094)	(0.082)	(0.118)	(0.082)
Employed	0.749	-0.358	-0.056	-0.494*
	(0.260)	(0.229)	(0.331)	(0.229)
Head of household	0.957	-0.201	0.532***	0.023
	(0.149)	(0.135)	(0.197)	(0.134)
Backward caste	0.848	-0.166	0.263	0.522**
	(0.175)	(0.181)	(0.239)	(0.182)
Private toilet	1.118	0.055	0.110	0.480*
	(0.215)	(0.188)	(0.270)	(0.192)
Pad users[+]	0.141	1.085***	1.744***	-1.561***
	(0.268)	(0.242)	(0.451)	(0.242)
Observations	554	554	554	554
Log Likelihood	622.127	884.763	486.738	936.395
Nagelkerke R^2	0.218	0.211	0.775	0.444

Note. Standard errors in parentheses.
Abbreviations. ANOVA = Analysis of variance. PI = Pad and Information. CI = Cloth and Information. OI = Only Information.
*** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$