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# Feasibility and Acceptability of Menstrual Cups for Addressing Period Poverty in Rural India: A Pilot Study in Spiti Valley

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## Abstract

**Introduction:** In Spiti Valley, located in the Himalayan region of Himachal Pradesh, India, women have been transitioning from using repurposed cloth to single-use menstrual products. Yet disposable products have created challenges for women and the environment in Spiti. Women lack affordable, convenient access to disposable products and burn or bury their used products due to a lack of waste infrastructure. Menstrual cups (MCs), a reusable product, may provide a solution to this multifaceted issue.

**Methods:** The purpose of this study was to assess the feasibility and acceptability of MC use in Spiti Valley using a cross-sectional study design. A baseline survey was conducted to assess MC feasibility with 36 participants. Six months after the baseline survey, a follow-up survey was conducted with 75 menstruators who had used a menstrual cup to assess the acceptability of MCs.

**Results:** Baseline findings indicated that 83.3% of study participants were interested in MCs, and interest was distributed evenly across age and other demographic categories. Findings from the follow-up survey indicated that all participants used their MC for at least three cycles, and the majority found it easy to use (82.7%) and expressed intent to continue using it (97.3%).

**Conclusions:** Given high rates of interest, reported ease of use, minimal issues, and overall satisfaction, menstrual cups are a feasible alternative to single-use pads in the Spiti Valley and other resource-limited rural settings.

**Keywords**: Menstrual Cups; Menstrual Health; Menstrual Hygiene Products; Period Poverty; Rural Population.

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## INTRODUCTION

Menstruation, the process of shedding the uterine lining, is one phase of the menstrual cycle experienced monthly by biological females during reproductive years. Despite the universality of menstruation, the menstrual cycle is stigmatized and shrouded in secrecy across populations and cultures [1,2]. A lack of open discussion about menstruation contributes to disparities and burdens for those who menstruate. Socially, menstruators are conditioned to conceal menstrual blood and worry about leakage during their cycles for fear of embarrassment and shame [3]. This burdens menstruators with the continual need to purchase menstrual products, which can be limited by financial and accessibility barriers [4].

When menstruators, especially young girls, lack access to menstrual products, adequate menstrual education, and private facilities to change their products, this is known as period poverty [4]. Period poverty exists globally and may contribute to both reproductive tract infections and missed school time [3,5]. Efforts to reduce period poverty have centered on providing disposable menstrual products for free or at a reduced cost, improving private bathroom facilities in schools, and enhancing menstrual education curricula for adolescent girls [1].

However, these efforts do not comprehensively address menstrual health, defined as "a complete state of physical, mental, and social well-being and not merely the absence of disease or infirmity, related to the menstrual cycle" [6]. Solely addressing product and bathroom access ignores a myriad of other challenges. Disposable menstrual products lead to an accumulation of slow-decomposing, biohazardous waste, adversely affecting the environment [7,8]. Women must also manage the disposal of used products by burying or burning them due to a lack of waste infrastructure [4]. This presents a social burden because women feel pressured to dispose of products in secret, especially in rural settings. Economically, the need for disposable menstrual products is recurring; a constant supply chain is needed at the community level, and money is needed at the individual level to maintain product access [9, 10]. Innovative approaches to reducing period poverty are needed to address these disparate but interrelated problems.

### *Menstrual Cups (MCs)*

Menstrual cups (MCs) are a more comprehensive approach to addressing period poverty. MCs are reusable silicone cups that are inserted into the vagina to collect menstrual fluid. They last for ten years and ultimately contribute less than 1.5% of the environmental burden caused by pad or tampon use [11]. In areas that lack a waste management system, MCs eliminate the need to dispose of non-degradable waste each month. Menstrual fluid is a bodily output that can be poured down toilets or latrines and handled along with other human excrement [12]. MCs are also economical, having a higher up-front cost than a box of single-use products, but eliminating the need to purchase new products for up to ten years [9]. MCs have added social benefits – they only need to be changed every twelve hours, so menstruators have longer periods of time before needing to change them [13]. MCs may also reduce exposure to the harmful chemicals (i.e., phthalates, parabens, phenols, and dioxins) that most disposable products contain [14]. They have not been found to increase urogenital infection risks from S. aureus, G. vaginalis, Candida, and E. coli [15]. MCs have numerous environmental, economic, social, and health advantages that disposable products do not.

These benefits have been observed in practice through the successful implementation of MC programs in various places [e.g., Kenya, 9; India, 16; Zimbabwe, 17; Nepal, 18]. A commonality among these programs is that most girls and women found MCs easy to use and clean, and less prone to leakage [16-18]. Schoolgirls from a study in Nepal reported

that using MCs enabled them to attend school without interruption during their period [18]. Babagoli and colleagues did a cost analysis and found that MC programs are up to seven times cheaper to implement per person than disposable pad programs [9]. Participants also noted the reduced economic burden and acceptability by their culture as positives of MCs [17,18]. A randomized control trial compared providing disposable pads versus MCs to schoolgirls in Kenya and found that MCs averted 1.4 DALYs associated with urogenital tract infections compared to the control group, whereas the disposable pad group averted 0.48 DALYs [9].

### *Menstrual Cups in Spiti Valley*

The isolated villages of Spiti Valley have unique conditions that lead to extreme period poverty. Over half of the women surveyed in three of these villages said that menstruating puts them at a disadvantage (data from an unpublished survey conducted in June 2022). Seventy-five percent of women use disposable pads, and 30% of women said they have difficulty getting pads because either the store did not have them, they were embarrassed, or they did not have enough money. This area lacks the infrastructure to support the use of disposable pads – these small villages are up to twenty miles from Kaza, the nearest town where pads can be purchased. When pads are used, the lack of a waste management system in the valley leads to women burying or burning their used products, causing environmental damage and health hazards. The advantages of MCs could address these barriers that women in Spiti face. It is against this backdrop that this study aimed to assess the feasibility and acceptability of MC use in the Spiti Valley.

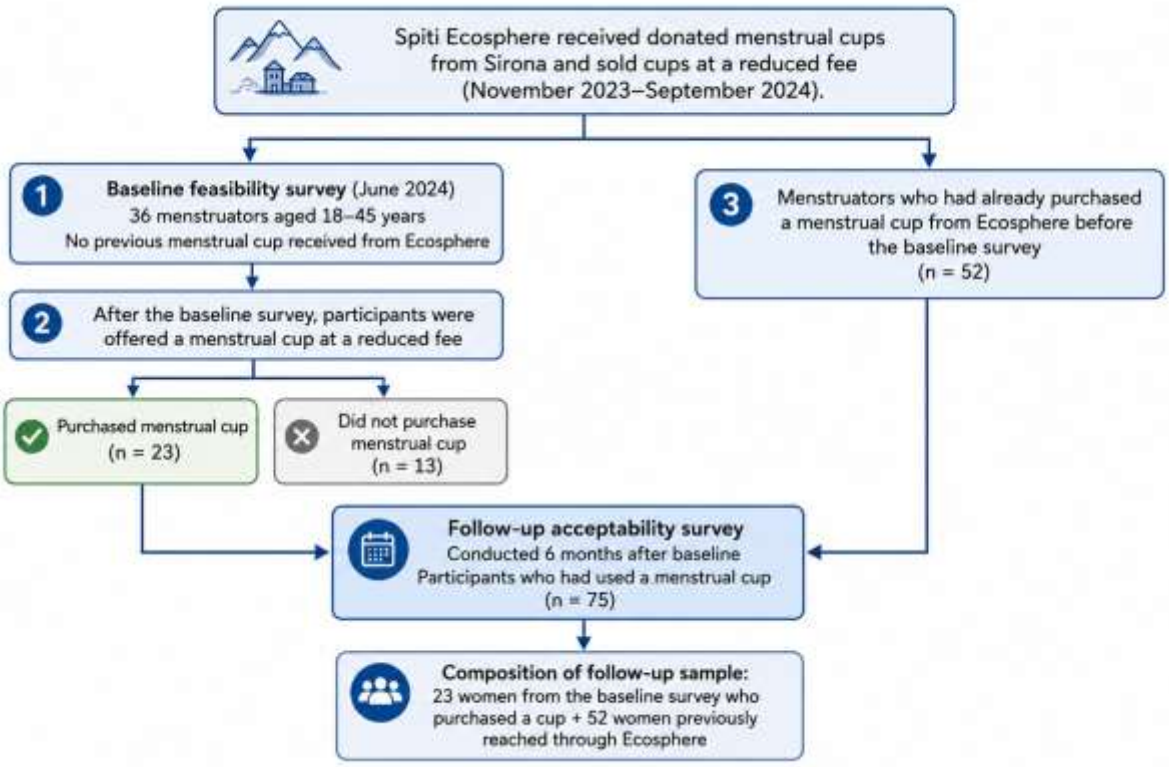
This study was built on ongoing menstrual health research in the Spiti Valley region of Northern India with local social enterprise and study partner Spiti Ecosphere. There has been anecdotal evidence that women in Spiti are interested in trying MCs, yet assessing the feasibility and acceptability of MCs in this region is imperative to the potential success of an MC program. Some cultures in India do not support the use of menstrual products that are inserted. Nearly all people in the Spiti Valley practice Tibetan Buddhism, and it is unknown if there are religious beliefs against the use of MCs in this population [19]. It is necessary to assess interest, ease of use, and educational needs before widespread implementation. This research contributes to the broader field of global menstrual health by providing insights into the factors that influence MC adoption in resource-limited rural communities.

## METHODS

### *Study design and population target*

This study aimed to assess the feasibility and acceptability of MC use in villages of the Spiti Valley, in Himachal Pradesh, India. The longitudinal (consisting of two cross-sectional surveys with different samples) study design is illustrated in Figure 1. Spiti Ecosphere, a local social enterprise and our study partner, received a donation of MCs from Sirona, a menstrual product company based in Delhi, India. Ecosphere sold these cups for a reduced fee to at least 52 menstruators between November 2023 and September 2024. In June of 2024, we enrolled 36 menstruators who had not received an MC from Ecosphere previously in a baseline feasibility survey. These 36 participants were then given the option to purchase an MC, 23 of whom did. Then, six months after the baseline survey, these 23 women and the additional 52 women who initially received an MC from Ecosphere were enrolled in a follow-up acceptability survey. A total of 75 participants were enrolled in the follow-up survey.

Figure 1. Study Design.




This study was conducted in villages in the Spiti Valley with menstruators aged 18-45, recruited using convenience sampling. The local amchi (traditional Tibetan medical practitioner), a community leader and key informant in this study, assisted with the recruitment of participants. The baseline survey was conducted in four villages, and the follow-up survey was conducted in these four and an additional seven villages where menstruators had already purchased MCs. The villages are approximately 10-20 miles from the central town of Kaza, located at the base of the Spiti Valley.

### *Study Instruments*

#### Baseline Survey

The baseline survey was designed based on the Menstrual Practices Questionnaire (MPQ) developed by Hennegan and colleagues [20] (Supplementary File 1). Participants were surveyed on their current menstrual hygiene practices, menstrual health knowledge and information sources, and their awareness and thoughts toward MCs. The survey was submitted to and approved by the Institutional Review Board of the University of Utah (IRB_00183595 dated 10/16/2024).

Upon recruitment to the study, women read through the informed consent document in Hindi with a translator present and had the opportunity to ask questions. The researcher then obtained written informed consent from women interested in participating. Following consent, the translator asked the participants the survey questions in Hindi or Piti (the local language) and relayed their answers in English to the researcher, who documented the answers. Study data were collected and managed using REDCap electronic data capture tools hosted by the University of Utah. Additional observational notes were also taken by the researchers about the participants' responses.

#### *Menstrual Cup Pilot*

After completing the survey, women had the option to purchase an MC in size small or medium for a reduced fee of 200 rupees (approximately $2.30 USD). The fee was charged to promote a sense of value and ownership toward the

cup and was intended to be affordable for all women in this area. The MC fees were collected by study partner Spiti Ecosphere. Women who purchased an MC were provided with education on how to use and clean the cup. This basic training was administered either by an Ecosphere staff member, in person by an ASHA worker (Accredited Social Health Activist, community health worker), or via a training video of an ASHA worker filmed by study staff. Each participant's contact information was then collected for the follow-up survey.

### Follow-up Survey

The follow-up survey was designed to assess the acceptability of MCs in the Spiti Valley. This survey was adapted from an unpublished menstrual health survey created by an international 501(c)(3) nonprofit organization running a similar MC pilot program in the Indian state of Bihar (Supplementary File 2). Participants were surveyed on details of their MC usage and their satisfaction with using the cup. The follow-up survey was conducted 6 to 13 months after women received their MC.

Written informed consent of the participants was obtained via REDCap upon their recruitment to the study, by study staff fluent in Hindi. Participants were given the opportunity to ask questions. The study staff then texted or emailed the participant the survey in Hindi via a REDCap link and assisted each participant with completing and submitting the survey. Each participant was then texted a copy of their signed consent form and survey answers.

### *Statistical Analysis*

The sample sizes were n = 36 for the baseline survey and n = 75 for the follow-up survey. The cleaned data were analyzed using Stata 18.0 (StataCorp. 2023. Stata Statistical Software: Release 18. College Station, TX: StataCorp LLC). Pearson's Chi-Square and One-Way ANOVA tests were performed to determine the statistical significance of correlations of interest. For the baseline survey data, categorical variables such as education and age were transformed into binary categorical variables. The categorizations were used to determine if different divisions by age resulted in different levels of significance for the correlations of interest. Figures and tables were created using Stata 18.0 and Microsoft Word (Microsoft Word, version 16.89.1).

### *Ethical aspects*

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of The University of Utah (IRB_00183595 dated 10/16/2024). Further clearance was obtained on October 16, 2024 (Approval ID: IRB_00183595). Informed consent was obtained from all subjects involved in the study.

## RESULTS

### *Baseline Survey*

### Demographics

Thirty-six women from the four study villages were surveyed. Demographic data for the population are presented in Table 1.

*Age.* Most participants (27.8%) were between the ages of 25 to 29, with representation across all age categories included. Over three-quarters of the participants were married. Age was a significant predictor of marital status, with a significantly higher percentage of women married in older age groups [$X^2$ (5, N = 36) = 23.85, $p < 0.001$].

*Education.* Over half of the participants had completed high school or more, with a handful of women having attained a bachelor's or graduate degree. Higher education was most common among women in village 1, with over half the sample having a bachelor's (n = 4) or graduate degree (n = 1), while there were only one or two women with higher degrees in the other villages. In all four villages, most of the participants had attained a higher education level than their parents – nearly all fathers and mothers had a high school education or less.

*Employment.* The participants' employment varied; the most frequent occupation types were self-employed (typically agriculture) and full-time employed (mostly government workers). Employment differed significantly by

marital status [$X^2$ (5, N = 36) = 15.70, p < 0.01]. All part-time employees, full-time employees, and homemakers were married, whereas students, self-employed, and unemployed participants were less likely to be married.

*Income.* The median income for the entire participant population was 25,000 rupees per month, but median income differed significantly between villages, [F(3, 32) = 39.70, p < 0.001]. Participants in villages 2 and 3 had nearly half the median monthly income compared to villages 1 and 4. Participants who attained a higher level of education also had significantly higher income levels [F(4, 31) = 8.72, p < 0.05].

**Table 1. Baseline Survey Participant Demographics.**

| Characteristic | Village 1 (n=8) | Village 2 (n=8) | Village 3 (n=10) | Village 4 (n=10) | Total (N=36) |
|---|---|---|---|---|---|
| **Age (n, %)** | | | | | |
| 18–24 years | 1 (12.5) | 1 (12.5) | 1 (10.0) | 2 (20.0) | 5 (13.9) |
| 25–29 years | 3 (37.5) | 2 (25.0) | 3 (30.0) | 2 (20.0) | 10 (27.8) |
| 30–34 years | 2 (25.0) | 3 (37.5) | 0 (0.0) | 2 (20.0) | 7 (19.4) |
| 35–39 years | 1 (12.5) | 0 (0.0) | 4 (40.0) | 1 (10.0) | 6 (16.7) |
| 40–44 years | 1 (12.5) | 2 (25.0) | 1 (10.0) | 3 (30.0) | 7 (19.4) |
| 45+ years | 0 (0.0) | 0 (0.0) | 1 (10.0) | 0 (0.0) | 1 (2.8) |
| **Marital status (n, %)** | | | | | |
| Married | 7 (87.5) | 7 (87.5) | 8 (80.0) | 6 (60.0) | 28 (77.8) |
| Unmarried | 1 (12.5) | 1 (12.5) | 2 (20.0) | 4 (40.0) | 8 (22.2) |
| **Education (n, %)** | | | | | |
| Less than high school | 0 (0.0) | 2 (25.0) | 5 (50.0) | 4 (40.0) | 11 (30.6) |
| High school degree | 2 (25.0) | 5 (62.5) | 3 (30.0) | 4 (40.0) | 14 (38.9) |
| Some college, no degree | 1 (12.5) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (2.8) |
| Bachelor's degree | 4 (50.0) | 1 (12.5) | 1 (10.0) | 2 (20.0) | 8 (22.2) |
| Graduate degree | 1 (12.5) | 0 (0.0) | 1 (10.0) | 0 (0.0) | 2 (5.6) |
| **Mother's education (n, %)** | | | | | |
| High school or less | 8 (100.0) | 8 (100.0) | 10 (100.0) | 9 (90.0) | 35 (97.2) |
| High school or more | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Unknown | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (10.0) | 1 (2.8) |
| **Father's education (n, %)** | | | | | |
| High school or less | 7 (87.5) | 8 (100.0) | 8 (80.0) | 8 (80.0) | 31 (86.1) |
| High school or more | 1 (12.5) | 0 (0.0) | 1 (10.0) | 1 (10.0) | 3 (8.3) |
| Unknown | 0 (0.0) | 0 (0.0) | 1 (10.0) | 1 (10.0) | 2 (5.6) |
| **Employment (n, %)** | | | | | |
| Unemployed | 1 (12.5) | 2 (25.0) | 1 (10.0) | 1 (10.0) | 5 (13.9) |
| Self-employed | 6 (75.0) | 3 (37.5) | 3 (30.0) | 1 (10.0) | 13 (36.1) |
| Part-time | 0 (0.0) | 1 (12.5) | 0 (0.0) | 0 (0.0) | 1 (2.8) |
| Full-time | 1 (12.5) | 2 (25.0) | 5 (50.0) | 1 (10.0) | 9 (25.0) |
| Student | 0 (0.0) | 0 (0.0) | 0 (0.0) | 3 (30.0) | 3 (8.3) |

| | | | | | |
|---|---|---|---|---|---|
| Homemaker | 0 (0.0) | 0 (0.0) | 1 (10.0) | 4 (40.0) | 5 (13.9) |
| **Income per month (rupee, ₹)** | | | | | |
| Median | 45,500 | 20,000 | 22,500 | 37,500 | 25,000 |
| IQR | 29,000–59,500 | 17,500–22,500 | 10,000–25,000 | 10,000–80,000 | 15,000–41,000 |

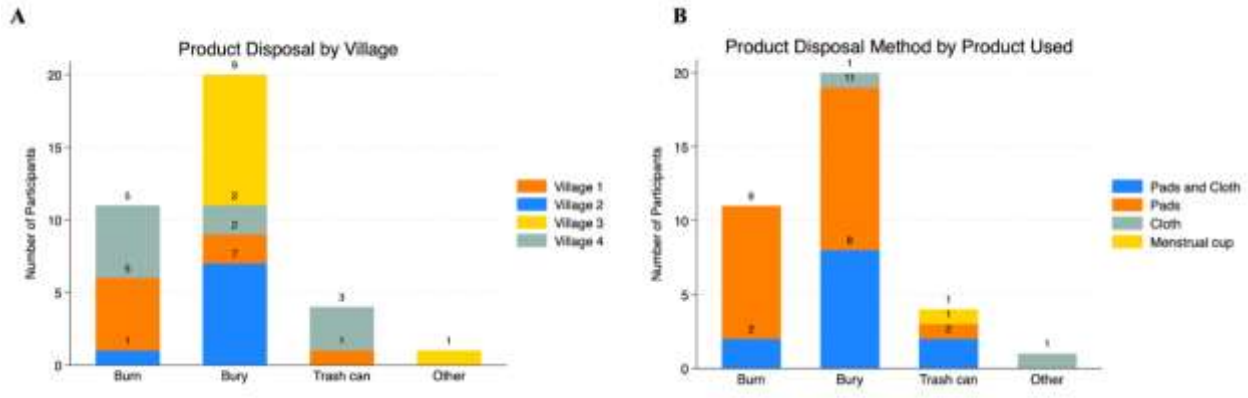
*Note: A one-way ANOVA found a significant difference in income by village ($p < 0.05$).*

## Current Menstrual Pratices

*Product Use.* In the baseline survey, most participants (58.3%) reported using just pads during their menstrual cycle, whereas 33.3% used a combination of pads and cloth, and only one woman reported using a menstrual cup (Supplementary Figure 1). The types of products used varied significantly by age [$X^2$ (3, N = 36) = 10.10, $p < 0.05$]. Participants 35 years and older were more likely to use a combination of pads and cloth or just cloth compared to participants under 35 years of age. Women under 35 years were more likely to use pads, and none used cloth exclusively.

*Product Disposal.* Burying was the most common method for disposing of used menstrual products, followed by burning. Methods of disposal varied significantly by village [$X^2$ (9, N = 36) = 22.87, $p < 0.01$] as shown in Figure 2A. Participants in villages 2 and 3 were more likely to bury used products, while participants in village 1 and village 4 typically burned their used products. Only four participants reported using trash cans to dispose of their products.

**Figure 2A and 2B.** Variation in Disposal Methods Across Villages and Product Used.



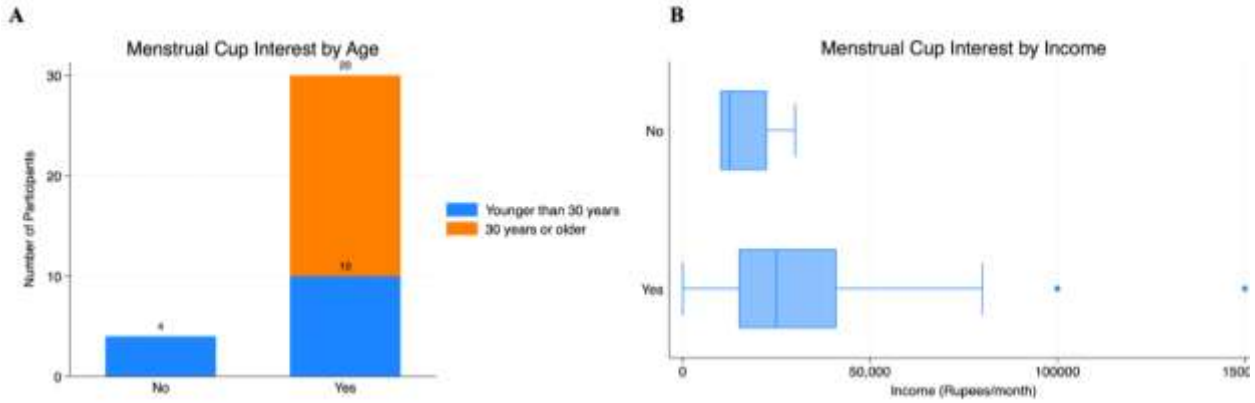

*Note:* Pearson's chi-square test found a significant difference between product disposal method by village ($p < 0.01$) and product types ($p < 0.01$).

Product disposal method also varied significantly by type of product [$X^2$ (9, N = 36) = 20.01, $p < 0.01$], as shown in Figure 2B. Participants who used both cloth and pads buried their used products more frequently, while those who exclusively used pads were more likely to burn their used products. Some of this variation is likely due to the nature of these products. For instance, women often reuse cloth, so there is no trash to be disposed of as regularly.

## Menstrual Cup Interest Trends

Most participants (83.3%) expressed interest in MCs. Interest varied significantly by age and income [$X^2$ (2, N = 36) = 6.51, $p < 0.05$] shown in Figure 3A and 3B. Participants 30 years and older were more likely to express interest in MCs than those 18-29 years old. Participants who expressed interest in MCs had a monthly median income of 25,000 rupees, twice that of participants who were not interested in MCs [$F(2, 33) = 3.09$, $p < 0.05$].

**Figure 3A and 3B.** Menstrual cup interest by age and income.




*Note:* 3A: A Pearson's chi-square test found a significant difference between the age categories ($p < 0.05$). 3B: The middle line represents the median, the edges of the box represent the 25th and 75th percentiles, and the whiskers represent minimum and maximum values excluding outliers. There were two outliers in the group interested in MCs. Two participants answered "unsure" and were excluded in this figure. A one-way ANOVA test found a significant difference by income ($p < 0.05$).

### Trends by Age

The age of participants predicted their awareness of alternative menstrual products. Participants between 18 and 30 years of age were significantly more likely to be aware of alternative menstrual products (products other than those they were currently using) compared to participants 30 years or older [$X^2$ (1, N = 36) = 3.86, $p < 0.05$] (Supplementary Figure 2). However, of the participants who were aware of an alternative product, those 30 years or older were more likely to have used an alternative product than those younger than 30 [$X^2$ (2, N = 36) = 7.04, $p < 0.05$]. Most participants across all age groups reported being aware of alternative products but had not tried these products.

Participants were asked whether they know anyone who uses an MC, and answers also differed significantly by age [$X^2$ (1, N = 36) = 11.23, $p < 0.001$]. The vast majority of women 35 years and older reported knowing someone who uses an MC, while the majority of participants below 35 years of age did not.

### Employment and Social Barriers

When asked whether they had any difficulty participating in social events during their last period, about half of the participants responded yes (Supplementary Figure 3). Type of employment was significantly associated with the presence or absence of social barriers during the menstrual cycle [$X^2$ (5, N = 36) = 9.92, $p < 0.077$]. Only homemakers reported no social barriers, whereas several participants in the unemployed, self-employed, part-time, full-time, and student categories did experience barriers.

### *Follow-up Survey*

A total of 75 participants from 11 villages were surveyed in the follow-up survey. All participants had used a menstrual cup. This included 23 women who had participated in the baseline survey and purchased an MC, as well as the 52 others who had previously purchased one from Ecosphere.

### Menstrual Cup Use

All women reported that they had used the MC for at least three cycles, with an average of 8.3 cycles and a maximum of 18 cycles (the variation was partly due to the length of time that women had the MC). Twenty-seven percent of participants reported using the MC in combination with pads. No participants indicated that they never used the MC or stopped using it. When asked how many times per day they removed and washed their MCs, 68% of participants reported three or more times a day, 30.67% reported twice a day, and 1.33% reported once a day.

Participants were asked where they learned about MCs and could select more than one answer. Most participants learned about MCs from Ecosphere, in addition to other sources, primarily friends, social media, and ASHA workers (Supplementary Figure 4). Participants who reported learning about MCs from ASHA workers were significantly younger than those who did not, by an average of about five years [$F(1, 75) = 6.01$, $p < 0.05$].

### Menstrual Cups as an Alternative

The follow-up survey results indicate that participants like using MCs and see them as a viable alternative to other menstrual products. The vast majority of participants (97.3%) said they would continue to use their MCs, and 82.7% found MCs easy to use. Seventy-three participants (97.3%) said that MCs were a good alternative to other products, and seventy-two (96%) said they would recommend MCs to others.

Participants were also asked what they liked about the MCs and were able to select multiple answers. The attribute of MCs that participants liked most was the lack of disposal, which seventy-four participants (98.7%) reported appreciating (Supplementary Figure 5). Thirty-four participants (45.33%) said they liked that their MC did not inhibit other activities like sleeping, traveling, or working. Participants also said they liked that their MCs were environmentally friendly (30.7%), did not leak (17.3%), and were easy to use (16.0%). The attributes least noted were that the MC was economical (12.0%) and could be used for longer hours than a pad (10.7%).

The follow-up survey also asked participants if they had promoted the use of MCs in their community. Twenty-nine participants (38.67%) reported that they had promoted MC use. These 29 participants were asked who they promoted MC use to and could select multiple answers. Eleven (37.9%) said they promoted MCs to friends, eight (27.6%) to their sisters, and seven (24.1%) to their sisters-in-law. The rest recommended MCs to aunts, daughters, or other women in their lives. Participants who reported promoting MCs to others were significantly younger than those who did not, by an average of about two years [$F(1, 75) = 5.23$, $p < 0.025$].

Participants were asked how much they would be willing to pay for an MC, and answers varied from 200 to 1000 rupees, with a mean of 592 rupees, all equal to or exceeding the price participants paid for their MC.

### Challenges with Menstrual Cups

Participants were asked if they required any help with information related to the use of MCs; 14 participants (18.67%) said yes, and 61 (81.33%) said no. Of the women who said yes, they sought help from friends, Ecosphere, family members, and ASHA workers.

Most participants (54.67%) reported that they encountered no concerns or problems while using their MC, while 34 (45.33%) participants reported they did (Supplementary Figure 6). The challenges participants selected were insertion/removal, leakage, and discomfort. No participants selected pain, allergies/infection, or itching/dryness.

The number of cycles participants using an MC was a significant predictor of whether they reported concerns or problems overall [$F(1, 73) = 10.26$, $p < 0.01$], as well as whether they expressed problems with insertion and removal specifically [$F(1, 73) = 9.90$, $p < 0.01$]. Fewer challenges were reported by participants who used the cup for more cycles. Twenty-nine (67.55%) of the participants said they sought help for challenges with MCs they experienced, and 14 (32.56%) said they did not. Significantly more participants who had difficulty with MC insertion or removal required assistance compared to those reporting other issues [$X^2$ $(1, N = 75) = 19.34$, $p < 0.001$].

## DISCUSSION

The study aimed to assess the feasibility and acceptability of MC use in the Spiti Valley in Himachal Pradesh, India. This pilot study demonstrated that MCs are a promising alternative to disposable menstrual products in the Spiti Valley of India. The promise of MCs may likely extend to other resource-limited rural communities and should be explored due to their environmental, social, and economic benefits.

### *Disposable Pad Use*

Menstruators across the world have been abandoning reusable, washable cloth in favor of disposable pads. This shift was evident in the results of the baseline survey, as the majority of participants used disposable pads (58.3%) or a combination of pads and cloth (33.3%). Participants who used cloth were significantly older than those who used disposable pads. This generational trend suggests that new menstruators are being introduced to disposable pads, and reusable cloth use may fade over time.

The global shift to disposable pads was spearheaded by NGOs and the water, sanitation, and hygiene (WASH) sector of public health. Bobel discusses how these agendas arose from the idea that a lack of access to menstrual products leads to educational disparities and health risks [3]. Pad campaigns in the Global South argue that greater access to pads will enable girls to stay in school during their cycles and will reduce risks of urogenital tract infections. Such campaigns have led to the Indian government increasing access to pads by lowering costs and providing free pads in schools [21]. This adoption was reflected in the results of this study.

### *Challenges with Disposable Products*

While disposable pads do have advantages, their widespread use also presents challenges, especially in isolated areas like the Spiti Valley, where there is no waste infrastructure. The majority of women reported burying or burning their used pads, which is environmentally harmful. Buried pads lead to an accumulation of slow-degrading waste and the leaching of chemicals into the surrounding soil and water [7, 11]. The open burning of pads also releases cancerous compounds called dioxins, which negatively impact human health when inhaled [22]. Our results suggest that the negative environmental and health impacts associated with the disposal of menstrual products are a significant concern in Spiti and all places where disposable pads are used.

While many studies discuss these environmental impacts, there is little documentation of the social burden associated with pad disposal [23]. Women in Spiti must find a place to hide used products during their cycle and take time to walk a distance from their villages for disposal. When asked about their greatest struggles related to their menstrual cycles, participants from all villages discussed pad waste and their desire for a "pad disposal machine." This social aspect of menstrual waste significantly impacts the lives of women in areas with limited waste infrastructure and warrants further study.

Another finding of interest was the correlation between employment type and whether women reported difficulty participating in social events during their last period. Homemakers were the only occupation that reported no social barriers, suggesting that spending time outside of the home while menstruating presents obstacles to full social participation. Lack of access to bathrooms to change menstrual products is a documented challenge, especially in school settings. Several studies find that attendance drops for many girls when they begin menstruating due to this barrier [24, 25]. Our results show that not just students, but also part-time, full-time, self-employed, and unemployed participants reported barriers. This may indicate that being outside the home more generally during menstruation is a challenge.

Using a commercial product also requires access to a reliable supply and consistent funds to purchase products. Pads have to be purchased in Kaza, the largest town in Spiti, up to twenty miles from these villages. While obtaining pads was not perceived as a burden to most of the survey participants, considering the cost and travel associated, obtaining pads may pose a challenge for some women in these villages. This economic burden associated with menstruation is significant to menstruators around the world, especially to disadvantaged groups [9, 26]. All economic and accessibility factors should be considered when designing menstrual health interventions.

### *Menstrual Cup Use*

MC campaigns show evidence of the cup's feasibility in multiple cultures and settings, and there are numerous initiatives to make cups more widespread [e.g., 9,16-18,27]. At the same time, there is justified criticism that some campaigns have lacked cultural humility and sensitivity and have pushed MCs on women who were not interested in using them [3]. One of the main goals of our study was to assess the interest in and acceptability of MCs in the Spiti Valley. The results of our surveys demonstrate that the vast majority of women (83.3%) are interested in MCs, and 91.7% agreed that the use of cups is accepted by their culture and religion.

We expected MC interest to be greatest in younger women who might be more open to new technologies and products. However, interest in MCs was high across all age ranges. Interest was actually highest among older women. Yet age was a predictor for awareness and use of alternative products. Younger women were more likely to be aware of alternatives than older women, perhaps because of their exposure to information from social media, friends, or school. Younger women were also more likely to know someone who uses an alternative product. However, significantly more older women had tried alternative products. The widespread awareness of and interest in MCs in the baseline survey led us to preliminarily conclude that this is a viable menstrual care alternative for menstruators of all ages in this area.

The follow-up survey indicated that women were not only willing to try MCs, but that they continued using them. At the time the follow-up was administered, all participants had tried their MCs and had used them for an average of 8.3 menstrual cycles. The responses to MCs were resoundingly positive, with the vast majority of participants stating that they would continue using them, they found them easy to use, that they are a good alternative to other menstrual products, and they would recommend them to others. Participants particularly appreciated not having to dispose of used menstrual products, alleviating the burden of burning or burying that comes with disposable product use in these communities. They also valued the environmentally friendly nature of MCs, highlighting that disposable products are not only difficult to dispose of but are also recognized as harming the communities' surroundings. MCs were also appreciated for their ease of use, lack of leakage, and that they could be worn during daily activities.

Participants who promoted MC use were significantly younger than those who did not, possibly because cultural norms that prohibit discussions of menstruation are less stringent for younger generations. Participants also stated that they would be willing to pay equal to or significantly more for an MC than the 200-rupee fee they paid during the pilot program. The prices participants reported are within the range of costs for MCs in Indian markets, which retail at about 399 rupees. The positive responses on these aspects of MC use are strong evidence that MCs are a better alternative to disposable menstrual products in Spiti and other resource-limited rural communities.

### *Barriers to Menstrual Cup Use*

Almost all the women enrolled in the baseline survey reported barriers that prevented them from using alternative products. One barrier was the cost of alternative products, evidenced by the correlation between higher incomes and MC interest. Women also discussed the lack of accessibility to MCs. However, these are not recurring barriers, unlike accessing disposable pads, and MC programs can help address these one-time barriers [9]. In Spiti, Ecosphere has helped address these barriers through its partnership with Sirona, an Indian menstrual product company. They can provide MCs to women who are interested throughout the valley at a reduced cost. Our findings indicate that accessibility and cost may be barriers to using alternative menstrual products in resource-limited rural communities and should be considered with program design or prior to promotion of these products.

In the follow-up survey, about half of the participants reported challenges when using MCs, such as problems with insertion or removal, leakage, and some discomfort. No participants reported pain, infections, or allergies, which are more severe challenges that could lead to future health problems. The challenges participants experienced suggest that formal MC training from Ecosphere staff or ASHA workers might prevent issues with MC use. It might also indicate

the value of MC training for doctors in Kaza who may be less familiar with this product and its proper use. Educational curricula that teach women how to use MCs and allow them to ask questions are needed.

Our findings suggest that there is an adjustment period when learning to use an MC. The longer participants used MCs, the fewer challenges they encountered. When they did face challenges, women sought help from other women, particularly friends and family. We expected that there would be a learning curve when trying a new menstrual product for the first time, particularly an insertable product. Our results indicate that women were able to navigate this adjustment period and become comfortable using MCs with support from their communities.

### *Menstrual Cups Globally*

The results of our study present overwhelmingly positive opinions of MCs. Interest and satisfaction were high across demographic categories, no women reported severe challenges with MC use, and nearly all women intended to continue using them. Similarly high levels of acceptability and lack of challenges have been found in other MC pilot studies in various settings and locations [16-18,27]. Our study corroborates these findings and adds valuable evidence that MCs can be successfully adopted in highly rural areas with limited economic stability, scarce access to healthcare providers, challenges with clean water availability, and strong cultural taboos against menstruation. Additionally, our study took a more comprehensive approach than previous studies. In-depth surveys that evaluated women's attitudes toward MCs were conducted among a large sample of menstruators in the area. This has provided strong evidence that women in Spiti would actually use MCs, because they not only experienced a few challenges with using them, but liked them. Our findings reinforce the growing body of evidence supporting MC adoption and demonstrate their viability even in the most resource-limited settings and demonstrate their potential for broader integration into communities worldwide.

### *Strengths and Limitations*

One strength of this study was its two time point cross-sectional surveys, which enabled us to monitor changes in knowledge, attitudes, and beliefs about MCs before and after use. However, both time points (baseline and follow-up) were non-equivalent and non-matched, and only collected data for 36 participants at baseline and 75 participants at follow-up. While it would have been valuable to have an increased sampling overall, the inclusion of participants in our follow-up survey who had received MCs through Ecosphere before our baseline survey enabled a robust follow-up survey. Moreover, the baseline survey collected feasibility data that were not necessary for the entire study population.

Our sample size of 75 lies within the range of other MC pilot program studies [16-18]. While this is not especially large, a significant proportion of menstruators in the village populations was surveyed, allowing for reasonable conclusions to be drawn.

While Spiti Valley differs culturally from other underserved areas, the eleven villages we surveyed were geographically isolated from each other and had varying beliefs about menstrual health. The study population was homogeneous in terms of race and ethnicity. However, there was good coverage of the range in age, income, employment, and education across the communities. We expect that the results of this study are generalizable to other resource-limited rural settings.

The study was limited by a lack of control over study conditions due to the constraints of working with these communities. The study did not utilize random sampling because the populations were small and communication was limited, and participants were interviewed in the same community space. While these are potential limitations, we value that this study design was community-informed and led, and participants were recruited and interviewed in the way that best suited their preferences.

## CONCLUSIONS

Our findings provide evidence that menstrual cups are a feasible and acceptable alternative to single-use disposable menstrual products in Spiti Valley, India, and by extension, other resource-limited rural areas. Participants were initially interested in trying menstrual cups, found them easy to use, had minimal challenges using them, and reported high overall satisfaction. We recommend the widespread implementation of menstrual cup programs to help address period poverty which affects so many women worldwide.

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**Institutional Review Board Statement:** The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of The University of Utah (IRB_00183595 dated 10/16/2024).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

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