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Socioeconomic and environmental determinants of menstrual hygiene management in rural west bengal: A mixed-methods study of bishnubar-I and golchak villages

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Abstract
Effective menstrual hygiene and sanitation is a very important aspect of women's general wellbeing, respect, and the environment. In the Bishnubar-I and Golchak villages, Purba Medinipur, West Bengal, MHM and sanitation practices among women were surveyed in 60 people. Researchers estimated adoption of menstrual products, disposal routines, sanitation infrastructure availability and how socio-economic backgrounds influence these practices. Sanitary pad or cloth is the most common choice among the respondents based on a majority of affordability and comfort considerations. Waste disposal ways varied; a large percentage of women hid or discarded sanitary waste in farmlands because there were no sufficient sanitation facilities. Inadequate sanitation at workplace was major impediments to proper conditions for women. Despite the efforts of ASHA and NGO workers to increase awareness, the residual financial barriers exerted continue to block further improvement in practices. The results emphasize that rural women need improved sanitation resources, affordable menstrual products, and education on menstrual waste disposal to reduce the challenges of menstrual hygiene.

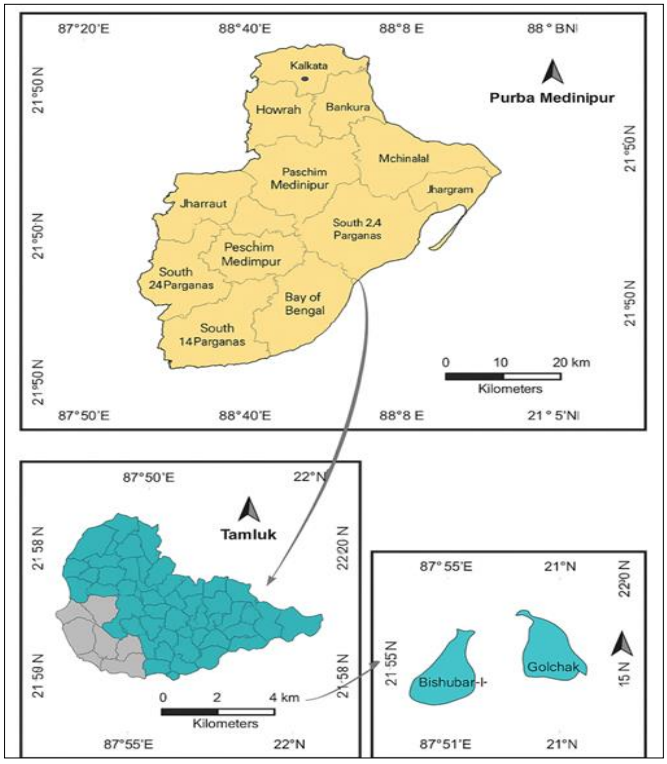
Keywords: Menstrual hygiene, sanitation, rural india, women's health, environmental impact

Introduction

Enhancing MHM is vital to public health because in many low resource settings, clean water, sanitation and affordable renewable menstrual products are non-existent. The poor implementation of MHM measures may lead to infections, reproductive health complications along with contamination of environment due to bad sanitary waste disposal (Hennegan, Dolan, Wu, Scott, & Montgomery, 2016) [2].

Building on Bishnubar-I and Golchak villages in Purba Medinipur, West Bengal, this research analyzes the role MHM practices, sanitation amenities, and socio-economic circumstances play on women's decisions. By pointing out these gaps, the research contributes to developing interventions oriented at women's health and environmental preservation.

Study Area



Source: Prepared using QGIS 3.26

Fig: 1

The research has been carried out in villages of Tamluk Community Development Block of Purba Medinipur district, West Bengal – Bishnubar-I and Golchak (Fig:1). Most of the region is rural and where people mainly exist on agriculture and small scale industries. The selected villages demonstrate typical rural settings in which women find difficulties accessing the appropriate sanitation and menstrual hygiene items.

Methodology

The project used a mixed-methods cross-sectional design which incorporated quantitative and deep qualitative analysis to study MHM and hygiene practices. To ensure a sample that would work on the basis of the age, profession and socio-economic diversities 60 women out of the Bishnubar-I and Golchak villages in Purba Medinipur, in West Bengal were selected by using targeted sampling. Participants were interviewed in-person to fill digital structured questionnaires which targeted demographic background, MHM routines, accessibility of sanitation and environmental vigilance.

QGIS 3.16 was used for geospatial mapping in the study for plotting sanitation points, water supply locations and waste disposal sites, which helped with the identification of accessibility issues. SPSS 20.0 was used to lead the statistical analysis which included computation of frequencies and percentages, and use of chi-square tests to examine relationships between such variables as income, education and the use of menstrual products. Qualitative data was categorized and explored for similar themes pointing to major problems and perceptions.

Use of the mixed methods approach helped to achieve triangulation, which in turn enhanced the credibility of the data. Ethical practice maintenance required obtaining informed consent and protecting the privacy of all the participants' data. These approaches provided a comprehensive picture of MHM barriers in rural communities, which in turn was carried over to concrete evidence-based policy proposals.

Significance of the Study

Improving the gaps in MHM and sanitation of rural West Bengal women is a key focus of this study. Negative strategies for dealing with menstruation may lead to health risk, gender imbalance exacerbation, and pollution of the environment; however, there is a dearth of thorough exploration in low-resource setting. An analysis of socio-economic difficulties, disposal customs facilitate the study's outcomes to influence policies, NGO plans, and educating activities regarding the provision of cost effective sanitary supplies of improved sanitation amenities. Further, the findings show how ASHA workers and education play a leading role in MHM practices improvement, contributing to global SDG 3 and SDG 6 achievements. The results can serve as a starting point for further research and development of effective and locally based methods of promoting sustainable menstrual well-being.

Results

From the 60 women that participated in the research held at Bishnubar-I and Golchak villages in Purba Medinipur, West Bengal, and the menstrual hygiene management (MHM) practices were investigated. Outcome showed that there were differences in a variety of MHM practices based on differences in socioeconomic status, education, and infrastructural provision.

It was a varied representation of women participants, where 70% of them were married and the rest 30% were unmarried or widowed. 45% of the participants were employed in the formal similarity sector, while 35% were homemakers or students and 20% in the informal economy. Educational backgrounds were highly diverse as 40% of participants had finished secondary school, 30% had graduated, and 30% had primary education or were not literate. Average monthly household earnings ranged from ₹2,000 to ₹60,000 and 60% of participants reported income of less than ₹10,000 in a month.

Independent Samples t-Test between menstrual blood-related Knowledge and Menstruation-related Knowledge

Table 1

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
menstrual blood-related Knowledge	Equal variances assumed	17.366	.000	-2.653	711	.006	-.123	.047	-.215	-.032
	Equal variances not assumed			-2.865	705.945	.003	-.123	.043	-.208	-.039
menstruation-related Knowledge	Equal variances assumed	41.196	.000	-1.399	711	.189	-.073	.051	-.172	.029
	Equal variances not assumed			-1.500	700.943	.132	-.073	.048	-.165	.022

Source: Primary data survey (2023-2024)

The t-test statistics (Table: 1) for menstrual blood-related knowledge indicate a statistically significant difference between non-working and working women. Levene's Test for Equality of Variances shows a violation of equal variances ($F = 17.366$, $p = 0.000$), so the "Equal variances not assumed" row should be used to interpret. The t-test value ($t = -2.865$, $df \approx 706$, $p = 0.003$) supports that working women possessed significantly greater knowledge about the nature of menstrual blood than their non-working peers. The mean difference (-0.123) with a 95% confidence interval from -0.208 to -0.039 suggests that not only is the difference statistically significant but also practically meaningful. Conversely, for overall menstruation-related knowledge, there is no statistically significant difference between groups. Although Levene's test once again reported unequal variances ($F = 41.196$, $p = 0.000$), the adjusted t-test ($t = -1.500$, $df \approx 701$, $p = 0.132$) indicates the difference in mean scores (-0.073) is not significant. The 95% confidence interval (-0.165 to 0.022) covers zero, reinforcing that the

groups do not differ significantly on this aspect of knowledge.

Disposal practices had environmental issues, with 45% disposing of menstrual waste in fields/ponds, 30% engaging in open dumping, and just 25% using proper disposal systems. Environmental awareness regarding effects was low, with 60% not knowing about pollution effects and just 15% trying eco-friendly disposal. Pearson correlation analysis indicated a positive correlation between education level and knowledge of proper disposal ($r=0.32$, $p=0.015$), indicating the influence of education on better waste management practices.

Sanitation infrastructure assessment revealed 80% coverage of toilets in households, although 50% had reported problems. Facilities at workplaces were poor for 60% of the respondents, with specific difficulties in female-specific facilities. Access to water was not uniform, with 70% relying on tube wells, 20% on tap water, and 10% on ponds, with 40% having irregular supply. Logistic regression also verified that improved sanitation access significantly predicted enhanced MHM practices.

Chi Square test between selected variables

Table: 2

Variables	Level of Knowledge related to menstrual blood			$\chi 2$	p-value
	Pure	Impure	Do not know		
Variables				23.955	0.002
Age Group (in Years)					
<=18	23(41.1)	14(25)	19(33.9)		
>18	70(18.5)	221(58.3)	88(23.2)		
Education Level				32.147	0.002
Illiterate to 5	9(15)	26(43.3)	25(41.7)		
6 to 10	28(14)	116(58)	56(28)		
> 10	56(32)	93(51.1)	26(14.9)		
Income in Rs.				8.269	0.062
<70,000	19(13.5)	81(57.4)	41(29.1)		
70,000- 273000	48(23.5)	99(52.1)	43(22.6)		
>273000	26(25)	55(52.9)	23(21.1)		
Social Media Access				19.915	0.003
Yes	68(29.2)	119(51.1)	48(19.7)		
No	25(12.4)	116(57.4)	61(30.2)		
Awareness Programme				13.353	0.001
Yes	36(29.3)	70(56.9)	17(13.8)		
No	57(18.3)	165(52.9)	90(28.8)		
Working Status				10.967	0.002
Working	52(22.9)	134(59)	41(18.1)		
Non-Working	41(19.7)	101(48.6)	66(31.7)		

Source: Primary data survey (2023-2024)

The chi-square test (Table: 2) of different socio-demographic and awareness-related factors with the knowledge level regarding menstrual blood identifies a number of significant trends:

First, age category has a statistically significant correlation ($\chi^2=23.955$, $p=0.002$) with views about menstrual blood. In those ≤18, 41.1% rated menstrual blood as "pure," whereas in the older category (>18), far fewer (18.5%) did so. Most in the older category (58.3%) rated it as "impure," implying that with age, conventional thought may become increasingly entrenched, or knowledge may remain restricted even after experience.

Education level also reflects a strongly significant relationship ($\chi^2=32.147$, $p=0.002$). Those with lesser education (to class 5) largely perceived menstrual blood as "impure" (43.3%) or were ignorant (41.7%), whereas those with education level higher than class 10 reflected a more progressive perspective with 32% of them perceiving menstrual blood as "pure" and just 14.9% in doubt. This highlights the vital importance of education in eradicating myths and encouraging menstrual health literacy.

Monthly earnings, nevertheless, did not indicate a statistically significant relation ($\chi^2=8.269$, $p=0.062$), implying that monetary status might not dictate awareness and perceptions regarding menstruation. This indicates that interventions need to be educational as well as community-based in nature instead of being simply income-based.

A strong association was found with social media access ($\chi^2=19.915$, $p=0.003$). Among those with access, 29.2% viewed menstrual blood as pure compared to only 12.4% among those without access. Similarly, fewer individuals with social media access were unaware of menstrual blood's nature. This highlights the potential of digital platforms as effective tools for MHM awareness dissemination.

Involvement in awareness programs was also strongly correlated ($\chi^2=13.353$, $p=0.001$) with improved knowledge. Individuals exposed to awareness drives were more likely to recognize menstrual blood as pure (29.3%) and with fewer rates of misinformation (13.8% unsure), highlighting the direct influence of community education.

Finally, working status was found to have a significant correlation ($\chi^2=10.967$, $p=0.002$). Working women had improved understanding, with 22.9% holding the view that menstrual blood is pure and only 18.1% were uncertain, in contrast to 31.7% of non-working women who were unclear. This confirms that exposure at work, social interaction, and economic independence can improve MHM knowledge.

Generally, the results suggest that education, access to digital technologies, exposure to awareness, and work are

significant drivers for enhancing menstrual knowledge and minimizing stigma. These factors ought to be the focal point of policy and programmatic approaches towards menstrual hygiene management in rural regions.

The results illustrate multifaceted interrelations between economic limitations, educational level, and infrastructure shortages in determining MHM behaviors. While cost continues to be a key deterrent, the findings underscore education and focused interventions as key leverage points for enhanced menstrual health outcomes in rural settings. The environmental impact of prevailing disposal methods only underscores the imperative towards sustainable approaches that recognize both health and ecological imperatives. These findings are consistent with the broader literature and offer targeted insight into the Purba Medinipur context. The proven efficacy of awareness programs warrants their scale-up, and the continued economic constraints highlight the imperative for subsidized product programs. Improvement in infrastructure, especially in sanitation at the workplace, presents itself as another vital intervention point on the basis of the findings. The quantitative outcomes of the study present quantifiable evidence to inform policy and resource allocation for MHM improvement programs in comparable rural contexts.

Discussion

Results from this study shed vital light into the intricate synergy of socioeconomic, infrastructural, and cultural forces determining menstrual hygiene management (MHM) for women in West Bengal's rural communities. These outcomes are commensurate with prevailing literature albeit in addition articulating context-sensitive difficulties that must be addressed using specialized interventions.

Socioeconomic Determinants of MHM Practices

The high correlation between education level and sanitary pad use (χ^2=8.72, p=0.013) supports earlier research proving that education empowers women to practice improved hygiene (Hennegan, Dolan, Wu, Scott, & Montgomery, 2016) [2]. The glaring difference between working (65% pad use) and non-working women (30%) also underscores affordability as a continued obstacle, in line with rural India findings (Van Eijk *et al*., 2016) [7]. The reality that 70% of poor households were not able to afford pads on a regular basis highlights the importance of subsidy programs such as Kerala's "She Pad" scheme, which distributes free sanitary products among schoolgirls. The multivariate analysis that identifies income (β=0.38), education (β=0.42), and awareness programs (β=0.35) as the primary predictors indicates that comprehensive interventions tackling multiple socioeconomic factors might be the most effective.

Menstrual Product Usage Patterns and Health Implications

The high incidence of cloth use (70% among non-working women) and poor washing habits (40%) are serious concerns for health.

Unsanitary cloth use has been associated with reproductive tract infections (Das *et al*., 2015) [1] and thus underscores the need for encouraging affordable substitutes. The result that 20% of pad users replaced them sparingly because of access problems reflects findings in sub-Saharan Africa (Sommer, Hirsch, Nathanson, & Parker, 2015) [5], and implies this is a worldwide problem in resource-poor environments. The success of ASHA/NGO programs (OR=3.1) in increasing adoption of pads illustrates the value of community health workers in filling the awareness-access gap, in line with demands to scale up such programs under India's National Health Mission. Environmental Implications of Menstrual Waste Disposal The dominance of environmentally unsound disposal practices (75% burial/open dumping) indicates a serious waste management infrastructure and awareness gap.

Although 60% of the respondents did not know about environmental effects, the positive relationship between education and correct disposal knowledge (r=0.32) indicates that school-based MHM education would foster sustainable behavior. The lack of incineration plants stands in stark contrast to urban areas where biomedical waste infrastructure is present, and the rural-urban gap in sanitation infrastructure is thus highlighted. This result lends support to decentralized solutions such as biodegradable pads or low-cost incinerators, as tested in Tamil Nadu's "Eco Femme" initiative. Sanitation Infrastructure and Accessibility Barriers the logistic regression finding that access to sanitation is an important improvement in MHM (OR=2.1) supports the WHO focus on integration of Water, Sanitation and Hygiene (WASH) within menstrual health initiatives. Yet, reporting insufficient workplace toilets (60%) and water shortages (40%) highlights systemic lapses in executing India's Swachh Bharat Mission at the local level.

The absence of gender-segregated toilets specifically impacts working women, mirroring UNICEF's (2019) [6] findings of how inadequate sanitation requires women to sacrifice hygiene.

The waterlogging problems (50% of households) are an under-studied issue in coastal areas such as Purba Medinipur, and thus climate resilience must be integrated into sanitation planning. Cultural Barriers and the Role of Awareness Programs The resilience of taboos (50% of the sample) in the face of decades of health promotion reflect fundamental sociocultural obstacles. This corroborates anthropological research that demonstrates menstrual stigma in rural India goes beyond economic development (Oster & Thornton, 2012) [4]. Meanwhile, the threefold increase in pad use by ASHA/NGO interventions demonstrates that dedicated community mobilization is able to change norms, such as observed in Nepal's "Rato Baltin" radio shows.

The hesitation of older women to use pads in the face of awareness (indicated by responses such as "not comfortable") implies inter-generational variations in acceptance, and therefore, age-specific communication strategies are needed.

Policy Implications and Intervention Pathways

Quantitative evidence from the study recommends three policy directions: First, economic interventions such as extending the GST-free pad scheme to rural subsidies. Second, infrastructure improvements with priority for gender-sensitive workplace toilets and water supply under Jal Jeevan Mission. Third, education reforms with MHM integration in school curriculum and ASHA training modules. Success with self-help group (SHG)-led pad production in nearby Odisha (Mohapatra, Mohanty, & Pattanayak, 2021) [3] indicates a replicable model of merging affordability with employment generation.

Limitations and Research Gaps

Although offering strong quantitative information, the cross-sectional nature of the study restricts causal inferences. The

self-reported nature of hygiene practices can introduce social desirability bias, and the small sample size limits generalizability. Longitudinal study designs ought to be used by future research to monitor intervention effects and investigate intersectional factors such as caste differences reflected in lower pad use among OBC participants (45% vs. general caste 65%).

Conclusion

Such investigation outlines the way in which such factors as poverty, environmental degradation, and cultural practices collectively mar menstrual health in rural West Bengal. The findings of the research highlight the need for such coordinated interventions, including the reduction in product costs by means of subsidies, eco-innovative waste management approaches, and culturally informed education by local communities. When interconnected strategies are related to SDG 3, 5, and 6 they make it such that everyone concerns the MEN's health as a national public concern instead of a nigh free bottom issue. Research in rural West Bengal points out frontline health workers can helpfully relate and lead in narrowing the gap in menstrual health, presenting a replicable strategy for other LMICs.

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