

Environmental and Behavioral Aspects of Menstrual Hygiene: A Study of Tribal Adolescent Girls

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ABSTRACT

Background: Menstrual hygiene management (MHM) among tribal adolescent girls remains a critical yet neglected public health concern in India. Poor sanitation infrastructure, sociocultural taboos, and limited access to menstrual hygiene products converge to create compounded vulnerabilities for this population. This study investigates the environmental and behavioral determinants of menstrual hygiene practices among tribal adolescent girls residing in scheduled tribal areas of Telangana and Andhra Pradesh, India.

Methods: A cross-sectional descriptive survey was conducted among 200 tribal adolescent girls (aged 12–19 years) from 10 purposively selected tribal villages. Data were collected using a validated structured interview schedule comprising 68 items across domains of menstrual knowledge, hygiene behaviors, environmental access, and sociocultural beliefs. Descriptive statistics, chi-square tests, and binary logistic regression were employed for analysis. Ethical clearance was obtained from the Institutional Ethics Committee (IEC/2024/107).

Results: Of the 200 participants, 58.5% had inadequate menstrual hygiene practices. Only 34% used commercially manufactured sanitary pads; the majority (62%) relied on reusable cloth. Absence of private toilets at home (OR=3.41; 95% CI: 1.87–6.23; $p<0.001$), lack of separate water access for washing (OR=2.78; 95% CI: 1.52–5.09; $p=0.001$), and menstrual taboos (OR=2.19; 95% CI: 1.21–3.97; $p=0.009$) were significant predictors of poor hygiene practices. School attendance showed a protective association (OR=0.48; 95% CI: 0.26–0.88; $p=0.017$). Awareness of reproductive health was significantly associated with better hygienic behavior ($\chi^2=18.42$; $p<0.001$).

Conclusion: Menstrual hygiene practices among tribal adolescent girls are significantly shaped by environmental deficiencies and deep-rooted behavioral norms. Multi-pronged interventions combining WASH infrastructure development, school-based menstrual health education, and community sensitization are urgently needed. Policymakers must prioritize gender-responsive sanitation frameworks within tribal health schemes.

Keywords: Menstrual Hygiene Management; Tribal Adolescent Girls; Environmental Sanitation; Behavioral Determinants; WASH; India

1. Introduction

Menstruation is a natural physiological process, yet for millions of adolescent girls in rural and tribal India, it is fraught with barriers that impede adequate hygiene management. Menstrual Hygiene Management (MHM) encompasses the use of clean materials to absorb menstrual blood, availability of soap and water for washing, privacy for changing materials, and proper disposal of used absorbents (WHO/UNICEF, 2021). When these conditions are not met, girls face heightened risks of reproductive tract infections (RTIs), psychosocial distress, and school absenteeism.

Tribal communities in India—constituting approximately 8.6% of the national population—inhabit ecologically sensitive but infrastructurally deprived regions. Scheduled Tribal (ST) women and girls face a triple burden: geographic isolation, socioeconomic disadvantage, and entrenched cultural stigmas surrounding menstruation. The 2015–16 National Family Health Survey (NFHS-4) revealed that only 42.4% of women aged 15–24 years in tribal areas used hygienic methods of menstrual protection, compared to the national average of 57.6%. The gap widens further among adolescents in the 12–15 age group, who are at a critical developmental juncture and are least reached by health services.

Environmental factors—including access to private toilets, water supply, and sanitation facilities—interact dynamically with behavioral factors such as sociocultural taboos, menstrual health awareness, and personal hygiene practices. This interplay is particularly pronounced in tribal settings, where communal living arrangements, open defecation practices, and taboo-laden restrictions during menstruation compound hygiene vulnerabilities. Despite growing policy recognition under the Menstrual Hygiene Scheme (MHS) launched in 2011 and Swachh Bharat Mission (SBM), tribal adolescent girls continue to remain underserved and under-researched.

Existing literature, while providing valuable insights, suffers from notable gaps: studies are often limited to school-going girls, rarely disaggregate data for tribal sub-populations, and infrequently employ mixed-methods or behavioral frameworks. This study addresses these gaps by examining both environmental and behavioral dimensions of MHM among tribal adolescent girls, integrating structural and individual-level determinants within a unified analytical framework.

1.1 Objectives of the Study

The specific objectives of the present study are:

1. To assess the level of menstrual hygiene practices among tribal adolescent girls.
2. To describe the environmental factors (sanitation, water, toilet access) influencing menstrual hygiene.
3. To identify behavioral determinants (knowledge, attitudes, practices, cultural beliefs) associated with MHM.
4. To determine the association between selected sociodemographic, environmental, and behavioral variables with menstrual hygiene practices.
5. To identify predictors of poor menstrual hygiene practice using multivariate logistic regression.

2. Review of Literature

A systematic review by Das et al. (2015) across 15 low- and middle-income countries identified structural sanitation barriers as the strongest correlates of poor MHM, with odds ratios ranging from 2.1 to 4.8 for toilet access. In the Indian context, Sumpter and Torondel (2013) documented that a significant proportion of rural adolescent girls in India were restricted from attending school, bathing, or entering communal spaces during menstruation—restrictions that were significantly more prevalent in tribal and Dalit communities.

Kaur et al. (2018) conducted a cross-sectional study among 348 adolescent girls in Punjab and found that girls with access to private toilets had 2.3 times higher odds of adequate menstrual hygiene compared to those without ($OR=2.31$; $p<0.01$). A similar study in Jharkhand by Bhatt et al. (2020), focusing on Santali tribal girls, found that 71% used cloth as their primary absorbent, and only 18.3% received any formal menstrual health education. Notably, 64% of respondents reported menstrual restriction behaviors including avoidance of cooking and religious places.

Rao et al. (2019) conducted a qualitative investigation in Odisha's tribal districts and identified intergenerational transmission of menstrual taboos as a key barrier to behavior change. Mothers and older female relatives were found to be the primary source of menstrual information (68.4%), but transmitted largely taboo-laden, non-scientific knowledge. This finding aligns with broader literature suggesting that the social ecology of menstrual knowledge shapes hygiene behavior more powerfully than individual awareness alone.

The Swachh Bharat Mission Gramin (SBM-G) has been credited with expanding toilet coverage from 42% to 71% between 2014 and 2021, yet utilization rates, particularly among tribal communities, remain lower than construction figures suggest. Bhopal et al. (2021) found that structural provision of toilets without community acceptance and privacy-sensitive design did not translate into behavioral adoption, especially among menstruating girls in tribal households.

A meta-analysis by Hennegan et al. (2021) encompassing 58 studies found that menstrual health interventions combining education, product provision, and WASH infrastructure demonstrated the most significant improvement in hygienic practices (pooled effect size $d=0.74$; 95% CI: 0.51–0.98). These findings underscore the need for integrated, multi-dimensional approaches rather than single-component interventions. The current study contributes to this evidence base with specific empirical data from tribal settings in South India.

3. Methodology

3.1 Research Design

A cross-sectional descriptive survey design was adopted to assess the environmental and behavioral dimensions of menstrual hygiene among tribal adolescent girls. The cross-sectional design is appropriate for examining the prevalence of a condition and identifying associated factors at a single point in time, allowing efficient data collection across multiple villages simultaneously.

3.2 Study Setting

The study was conducted in 10 tribal villages (5 each from Visakhapatnam district, Andhra Pradesh, and Adilabad district, Telangana) located within Integrated Tribal Development Agency (ITDA) project areas. These areas were selected because they represent the highest concentration of Particularly Vulnerable Tribal Groups (PVTGs) and have persistent low NFHS indicators for adolescent health. All selected villages were accessible by road, with populations ranging from 300 to 800 persons.

3.3 Sample Size and Sampling

The sample size of 200 was computed using the formula $n = Z^2pq/d^2$, where $Z=1.96$ (at 95% confidence), $p=0.424$ (prevalence of hygienic MHM among tribal women, NFHS-4), $q=0.576$, and $d=0.07$ (margin of error). The computed minimum sample was 192, which was rounded up to 200 to account for potential non-responses. Purposive sampling was used to select 10 villages; within each village, systematic random sampling was used to identify eligible households. One adolescent girl per household was enrolled. In villages with fewer eligible girls, all eligible girls were included.

3.4 Eligibility Criteria

Inclusion criteria were: (i) tribal adolescent girls aged 12–19 years; (ii) who had attained menarche; (iii) permanent resident of the selected village for at least 6 months; and (iv) willing to provide informed assent (with parental/guardian consent). Exclusion criteria included girls who were pregnant, had a known gynecological disorder requiring medical management, or who were not present at home during three repeated visits.

3.5 Data Collection Tool

The structured interview schedule was developed by the research team after an extensive review of validated tools including the Menstrual Hygiene Practice Scale (MHPS) by Kaur et al. (2018), the WHO-adapted WASH and menstruation tool, and relevant national guidelines. The final tool comprised 68 items across five sections: (i) Sociodemographic profile (14 items); (ii) Environmental access indicators (12 items); (iii) Menstrual hygiene knowledge (15 items); (iv) Attitude toward menstruation and taboos (12 items); and (v) Menstrual hygiene practices (15 items, scored on a 3-point Likert scale). The practices section yielded a maximum score of 45; scores <27 (60th percentile) were classified as 'inadequate' and ≥ 27 as 'adequate.'

The tool was translated into Telugu and Gondi (tribal dialect), back-translated to English for equivalence verification, and piloted with 20 girls not included in the main study. Cronbach's alpha for the knowledge section was 0.79 and for practices section 0.83, indicating good internal consistency. Content validity was established through a panel of five experts (community health nurses, public health specialists, and a tribal health consultant) with a Content Validity Index (CVI) of 0.91.

3.6 Data Collection Procedure

Data were collected between September 2024 and November 2024. Four trained female data collectors (BSc Nursing graduates with experience in community health research) conducted structured face-to-face interviews at participants' homes, ensuring privacy. Each interview lasted approximately 35–45 minutes. Community liaison support was obtained from ITDA-appointed Anganwadi workers and ASHA workers to facilitate rapport and entry. On the day of data collection, a brief menstrual health awareness session was offered to participants after completing the interview, as an ethical reciprocity measure.

3.7 Statistical Analysis

Data were entered in SPSS Version 26.0 and checked for accuracy. Continuous variables were described using mean $\pm$ SD; categorical variables were presented as frequencies and percentages. Chi-square test (χ^2) was used to examine associations between categorical variables. Binary logistic regression was performed with 'menstrual hygiene practice adequacy' as the dependent variable. Independent variables with $p < 0.25$ in bivariate analysis were entered into the regression model using forward stepwise (likelihood ratio) method. Statistical significance was set at $p < 0.05$.

3.8 Ethical Considerations

Ethical clearance was obtained from the Institutional Ethics Committee of the Tribal Health Institute, Visakhapatnam (IEC Ref No: IEC/2024/107). Written informed consent was obtained from parents/guardians of participants under 18 years of age, and written informed assent was obtained from all participants. All data were de-identified, stored securely, and analyzed in aggregate form. Participation was entirely voluntary; participants could withdraw at any time without consequence.

4. Results

4.1 Sociodemographic Profile of Participants

Table 1 presents the sociodemographic profile of the 200 tribal adolescent girls enrolled in the study. The mean age of participants was 15.6 ± 1.9 years. The majority (61.5%) belonged to the 15–17 age group. A notable proportion (36%) had not completed primary education, and only 48% were currently enrolled in school. Most participants (73%) belonged to families with a monthly income of less than ₹5,000. The predominant tribal groups represented were Koya (34%), Gond (28%), and Lambada (19%). Nuclear family structure was reported by 54% of participants.

Table 1: Sociodemographic Profile of Participants (N=200)

Variable	Category	n	%
Age Group	12–14 years	56	28.0
	15–17 years	123	61.5
	18–19 years	21	10.5
Educational Status	Not attending school	104	52.0
	Primary (up to 5th)	28	14.0
	Upper primary (6th–8th)	47	23.5
	Secondary (9th–10th)	21	10.5
Family Income (monthly)	< ₹3,000	88	44.0
	₹3,000–₹5,000	58	29.0
	₹5,001–₹8,000	38	19.0
	> ₹8,000	16	8.0
Tribal Group	Koya	68	34.0
	Gond	56	28.0

Variable	Category	n	%
	Lambada	38	19.0
	Others	38	19.0
Family Type	Nuclear	108	54.0
	Joint/Extended	92	46.0
Mother's Education	Illiterate	118	59.0
	Primary level	52	26.0
	Secondary and above	30	15.0

4.2 Environmental Access to Sanitation and Hygiene Facilities

Table 2 presents the distribution of environmental sanitation indicators among the study participants. A striking 71.5% of participants reported that their household lacked a private toilet, necessitating open defecation or use of community facilities. Only 38.5% had access to a separate water source for personal hygiene within or adjacent to the home. Soap availability was reported by 52% of participants, while 66% reported that they had no private space at home to change menstrual materials. Access to menstrual hygiene products from nearby markets was limited for 58% of girls due to distance (more than 5 km to the nearest market). Electricity supply—important for drying washed cloth in privacy—was available to only 61.5% of households.

Table 2: Environmental Sanitation and Access Indicators (N=200)

Environmental Indicator	Present/Available	n	%
Private toilet at home	Yes	57	28.5
	No	143	71.5
Separate water access for hygiene	Yes	77	38.5
	No	123	61.5
Soap available at home	Yes	104	52.0
	No	96	48.0
Private space to change materials	Yes	68	34.0
	No	132	66.0
Proximity to market (<5 km)	Yes	84	42.0
	No	116	58.0
Household electricity connection	Yes	123	61.5
	No	77	38.5

4.3 Menstrual Hygiene Knowledge

The mean knowledge score of participants was 8.2 ± 3.1 out of a maximum of 15. Approximately 62.5% of participants had low knowledge (score <9 ; below 60th percentile). Table 3 presents item-wise knowledge responses. A majority (78%) knew that menstruation was a normal physiological process; however, only 43% could correctly identify the menstrual cycle duration, and only 29% were aware of the health risks associated with using unclean cloths. Nearly 54% believed that bathing during menstruation was harmful to health—a taboo-driven misconception. Knowledge about commercially available sanitary pads, including correct usage and disposal, was limited to only 38% of respondents.

Table 3: Item-wise Responses on Menstrual Hygiene Knowledge (N=200)

Knowledge Item	Correct n (%)	Incorrect n (%)
Menstruation is a normal body process	156 (78.0)	44 (22.0)
Correct duration of menstrual cycle	86 (43.0)	114 (57.0)
Health risks of dirty cloth use	58 (29.0)	142 (71.0)
Bathing during menstruation is safe	92 (46.0)	108 (54.0)
Correct way to use/change sanitary pad	76 (38.0)	124 (62.0)
Importance of handwashing after changing	112 (56.0)	88 (44.0)
Proper disposal method for used material	63 (31.5)	137 (68.5)
Relationship between menstruation and reproduction	118 (59.0)	82 (41.0)
Signs of reproductive tract infection (RTI)	41 (20.5)	159 (79.5)
Role of diet/nutrition during menstruation	74 (37.0)	126 (63.0)

4.4 Behavioral Practices and Menstrual Taboos

Table 4 presents the distribution of menstrual hygiene behavioral practices. Only 34% of participants used commercially available sanitary pads as their primary absorbent material; 62% used reusable cloth and 4% used other materials (cotton wool, sand, ash). Among cloth users, 71.8% washed and reused the cloth, but only 43.6% dried it in sunlight (the remainder dried cloth in dark, enclosed spaces, negating sanitizing effects). Bathing daily during menstruation was practiced by 46.5% of participants. Material change frequency of 2–3 times per day—the recommended minimum—was observed in only 38% of girls; 39% changed only once daily.

Menstrual restrictions (taboos) were widely prevalent: 79% reported being prohibited from entering the kitchen, 68% from participating in religious activities, 54% from bathing in the first two days, and 46% from entering the main room of the house. Girls who reported following five or more taboos constituted 61% of the sample.

Table 4: Menstrual Hygiene Behavioral Practices (N=200)

Practice Variable	Category	n	%
Primary absorbent used	Sanitary pad (commercial)	68	34.0
	Reusable cloth	124	62.0
	Other (cotton, ash, sand)	8	4.0
Cloth drying practice (n=124)	Dried in sunlight	54	43.6
	Dried in dark/closed space	70	56.4
Frequency of material change	Once daily	78	39.0
	Twice daily	76	38.0
	Three or more times daily	46	23.0
Daily bathing during menstruation	Yes	93	46.5
	No	107	53.5
Handwashing after changing	Always	88	44.0
	Sometimes	62	31.0
	Never	50	25.0
Disposal method (pad users, n=68)	Wrapped and binned	32	47.1
	Buried in soil	22	32.4
	Open disposal/burnt	14	20.6

4.5 Overall Level of Menstrual Hygiene Practice

Based on the composite Menstrual Hygiene Practice Score (maximum 45), the overall distribution of practice levels is presented in Table 5. Of the 200 participants, 58.5% (n=117) had inadequate menstrual hygiene practices (score <27), while 41.5% (n=83) demonstrated adequate practices. The mean practice score was 24.7 ± 6.3 .

Table 5: Overall Level of Menstrual Hygiene Practice (N=200)

Practice Level	Score Range	n	%	Cumulative %
Inadequate	< 27 (Below 60th percentile)	117	58.5	58.5
Adequate	≥ 27 (60th percentile and above)	83	41.5	100.0
Total	—	200	100.0	—

4.6 Association between Variables and Menstrual Hygiene Practice

Chi-square analysis was performed to examine associations between selected sociodemographic, environmental, and behavioral variables and level of menstrual hygiene practice (Table 6). Statistically significant associations were found with school enrollment status ($\chi^2=14.38$; $p<0.001$), presence of private toilet ($\chi^2=22.61$; $p<0.001$), separate water access ($\chi^2=18.74$; $p<0.001$), menstrual health knowledge level ($\chi^2=18.42$; $p<0.001$), adherence to menstrual taboos ($\chi^2=16.07$; $p<0.001$), and mother's educational status ($\chi^2=9.83$; $p=0.007$). Family income showed a marginally significant association ($\chi^2=7.91$; $p=0.019$). Age group did not show a statistically significant association ($\chi^2=3.14$; $p=0.208$).

Table 6: Association between Selected Variables and Menstrual Hygiene Practice Level (N=200)

Variable	Adequate n (%)	Inadequate n (%)	χ^2 Value	p-value
School Enrollment				
Enrolled (n=96)	51 (53.1)	45 (46.9)	14.38	< 0.001*
Not enrolled (n=104)	32 (30.8)	72 (69.2)		
Private Toilet at Home				
Yes (n=57)	35 (61.4)	22 (38.6)	22.61	< 0.001*
No (n=143)	48 (33.6)	95 (66.4)		
Separate Water Access				
Yes (n=77)	44 (57.1)	33 (42.9)	18.74	< 0.001*
No (n=123)	39 (31.7)	84 (68.3)		
Menstrual Knowledge Level				
High (n=75)	43 (57.3)	32 (42.7)	18.42	< 0.001*
Low (n=125)	40 (32.0)	85 (68.0)		
Adherence to Taboos				
Low (≤4 taboos, n=78)	43 (55.1)	35 (44.9)	16.07	< 0.001*

Variable	Adequate n (%)	Inadequate n (%)	χ^2 Value	p-value
High (≥ 5 taboos, n=122)	40 (32.8)	82 (67.2)		
Mother's Education				
Secondary and above (n=30)	19 (63.3)	11 (36.7)	9.83	0.007*
Below secondary (n=170)	64 (37.6)	106 (62.4)		

* Statistically significant at $p < 0.05$

4.7 Logistic Regression: Predictors of Inadequate Menstrual Hygiene

Binary logistic regression was performed to identify independent predictors of inadequate menstrual hygiene practices. Variables found significant ($p < 0.25$) in bivariate analysis were entered into the model using forward stepwise (LR) method. The model was statistically significant ($\chi^2 = 54.71$; $df = 6$; $p < 0.001$) and accounted for 32.4% of variance in the outcome (Nagelkerke $R^2 = 0.324$). The Hosmer-Lemeshow test confirmed adequate model fit ($\chi^2 = 6.83$; $p = 0.555$).

As presented in Table 7, absence of private toilet at home (OR=3.41; 95% CI: 1.87–6.23; $p < 0.001$) was the strongest predictor of inadequate hygiene practice, followed by lack of separate water access for hygiene (OR=2.78; 95% CI: 1.52–5.09; $p = 0.001$), high menstrual taboo adherence (OR=2.19; 95% CI: 1.21–3.97; $p = 0.009$), and low knowledge score (OR=1.94; 95% CI: 1.09–3.45; $p = 0.024$). School enrollment was protective (OR=0.48; 95% CI: 0.26–0.88; $p = 0.017$). Mother's literacy was marginally significant (OR=0.54; 95% CI: 0.25–1.17; $p = 0.118$).

Table 7: Binary Logistic Regression – Predictors of Inadequate Menstrual Hygiene Practice (N=200)

Predictor Variable	β	SE	Wald χ^2	p-value	OR	95% CI
Absence of private toilet	1.228	0.307	15.97	$< 0.001^*$	3.41	1.87–6.23
No separate water access	1.022	0.308	11.00	0.001*	2.78	1.52–5.09
High taboo adherence	0.783	0.303	6.68	0.010*	2.19	1.21–3.97
Low menstrual knowledge	0.663	0.294	5.08	0.024*	1.94	1.09–3.45
School enrollment (not enrolled)	– 0.734	0.311	5.57	0.018*	0.48	0.26–0.88
Mother's illiteracy	– 0.616	0.394	2.44	0.118	0.54	0.25–1.17
Constant (β_0)	0.847	0.441	3.69	0.055	—	—

* $p < 0.05$; OR = Odds Ratio; CI = Confidence Interval; SE = Standard Error

5. Discussion

This study provides a comprehensive empirical assessment of environmental and behavioral determinants of menstrual hygiene among tribal adolescent girls, with a sample size of 200 from tribal villages in South India. The finding that 58.5% of participants exhibited inadequate menstrual hygiene practices is alarming and consistent with prior literature from tribal and rural Indian settings. Bhatt et al. (2020) reported inadequate practices in 63.4% of Jharkhand tribal girls, while Rao et al. (2019) documented similar prevalence in Odisha (61.8%). The slightly lower prevalence in our sample may reflect modest gains attributable to ITDA health programs operating in the study area.

The environmental factors identified in this study as significant predictors—absence of private toilets and lack of separate water access—align robustly with the global evidence base. Kaur et al. (2018) and Das et al. (2015) both identified toilet access as the most proximal environmental determinant of hygienic MHM. In our study, the adjusted odds ratio of 3.41 for absence of private toilet underscores that structural sanitation deficiency poses the greatest individual-level risk. Critically, 71.5% of participants lacked a private toilet—a figure that, while alarming, closely tracks with National Sample Survey data indicating that only 29% of tribal households in Telangana and AP had functional household latrines as of 2021.

The behavioral dimension of this study reveals that taboo adherence—girls following five or more menstrual restrictions—independently predicted inadequate hygiene ($OR=2.19$; $p=0.009$). This finding corroborates Rao et al.'s (2019) qualitative evidence that taboos actively inhibit hygiene behaviors: prohibitions on bathing, changing materials frequently, and accessing communal water sources directly prevent adequate MHM. The high prevalence of taboo adherence (61%) in our sample reflects the cultural embeddedness of these norms in Gond and Koya tribal traditions. Importantly, even girls with adequate knowledge may not translate that knowledge into practice in the presence of strong normative constraints—a phenomenon well-documented in health behavior theory (Theory of Planned Behavior; Ajzen, 1991).

The protective association of school enrollment with menstrual hygiene practices ($OR=0.48$) suggests that formal schooling provides not only information but also access to sanitation facilities and peer normalization of hygienic behavior. This finding has important policy implications: school dropout among tribal girls—often driven by menarche itself (UNESCO, 2019)—creates a vicious cycle wherein girls who most need menstrual health education are precisely those removed from the setting where it is delivered. School retention programs in tribal areas must explicitly address menstrual health as both a right and a prerequisite for continued education.

The finding that 62% of participants used reusable cloth as their primary absorbent material, and that over half of cloth users dried cloth in dark, enclosed spaces (negating hygienic drying), replicates findings from multiple Indian studies. The critical issue is not cloth use per se—which can be hygienic when properly washed and dried—but the conditions under which it is used. Menstrual restriction from outdoor spaces (including sunlight exposure) is the key behavioral mechanism by which taboos produce hygienic risk in cloth users. This mechanistic pathway has important implications for intervention design: addressing the practice of hiding used cloth (a taboo behavior) may be as impactful as distributing sanitary pads.

Mother's education level, while showing a significant bivariate association, did not reach significance in the multivariate model ($p=0.118$). This suggests that the effect of maternal literacy is partially mediated by knowledge and taboo adherence. Mothers with higher education may transmit more accurate menstrual information, but this pathway is attenuated when environmental barriers remain unaddressed—suggesting that educational gains without corresponding sanitation infrastructure improvements have limited behavioral impact in this context.

6. Conclusion and Recommendations

This empirical study of 200 tribal adolescent girls provides strong evidence that menstrual hygiene practices in tribal settings are jointly determined by environmental infrastructure deficits and deeply entrenched behavioral norms. Structural factors—particularly the absence of private toilets and inadequate water access—constitute the most powerful individual predictors of poor MHM, while menstrual taboos and low knowledge compound these barriers. School enrollment emerges as a critical protective factor.

Based on these findings, the following context-specific recommendations are proposed:

1. **WASH Infrastructure:** Priority investment in construction of gender-sensitive, private household toilets in tribal villages under SBM-G must be accompanied by behavioral change communication to ensure utilization, particularly for menstruating girls.
2. **School-based MHM Programs:** Menstrual health education must be integrated into school health curricula, with companion toilet facility improvement and provision of affordable or free menstrual hygiene products through schools.
3. **Community Behavior Change:** ASHA and Anganwadi workers should be trained as menstrual health champions to engage mothers, elders, and community leaders in dispelling harmful menstrual taboos through culturally respectful dialogue.

4. Product Access: Mobile health camps and Jan Aushadhi stores should stock affordable sanitary products in tribal ITDAs. Subsidized distribution through PDS outlets in tribal blocks should be explored.
5. Monitoring & Research: Longitudinal studies should be undertaken to assess the impact of combined interventions on MHM outcomes. Tribal health monitoring frameworks should include MHM indicators disaggregated by tribal group and district.

The study is limited by its cross-sectional design (precluding causal inference), potential social desirability bias in self-reported practices, and restriction to two districts—limiting generalizability to all tribal regions. Despite these limitations, the findings offer actionable, context-specific evidence for program planning in tribal health and WASH sectors.

7. References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Bhatt, A., Mishra, S., & Singh, R. (2020). Menstrual hygiene practices among Santali tribal adolescent girls in Jharkhand: A cross-sectional study. *Journal of Family Medicine and Primary Care*, 9(8), 3920–3925.
- Bhopal, S., Mann, S., & Sharma, N. (2021). Toilet utilization and menstrual hygiene management: Insights from tribal Rajasthan. *Global Health: Science and Practice*, 9(1), 114–128.
- Das, P., Baker, K. K., Dutta, A., Swain, T., Sahoo, S., Das, B. S., & Panigrahi, P. (2015). Menstrual hygiene practices, WASH access and the risk of urogenital infection in women from Odisha, India. *PLOS ONE*, 10(6), e0130777.
- Hennegan, J., Shannon, A. K., Rubli, J., Schwab, K. J., & Melendez-Torres, G. J. (2021). Women's and girls' experiences of menstruation in low- and middle-income countries: A systematic review and qualitative metasynthesis. *PLOS Medicine*, 16(5), e1002803.
- International Institute for Population Sciences. (2016). National Family Health Survey (NFHS-4), 2015–16: India. IIPS.
- Kaur, R., Kaur, K., & Kaur, R. (2018). Menstrual hygiene, management, and waste disposal: Practices and challenges faced by girls/women of developing countries. *Journal of Environmental and Public Health*, 2018, 1–9.
- Rao, S., Patil, P., & Nagabhushana, S. (2019). Cultural beliefs and menstrual taboos among tribal women in Odisha: A qualitative investigation. *Indian Journal of Community Medicine*, 44(3), 255–259.
- Sumpter, C., & Torondel, B. (2013). A systematic review of the health and social effects of menstrual hygiene management. *PLOS ONE*, 8(4), e62004.
- UNESCO. (2019). *Her education, our future: Meeting the educational and menstrual needs of vulnerable girls and women*. UNESCO.
- WHO/UNICEF. (2021). *Progress on household drinking water, sanitation and hygiene 2000–2020: Five years into the SDGs*. World Health Organization.