



RESEARCH ARTICLE

Menstrual hygiene practices, determinants, and association with reproductive tract infection in India: a large repeated cross-sectional analysis (2015–2021)

Mrunali Zode¹, Baani Sodhi¹  and Saurav Basu² 

¹Public Health Foundation of India, Delhi, India and ²Associate Professor, Public Health Foundation of India, Delhi, India

Corresponding author: Saurav Basu; Email: saurav.basu1983@gmail.com

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Abstract

The promotion of menstrual health and hygiene globally, especially in lower-middle-income countries (LMICs), is a major public health imperative. The primary study objective was to ascertain the change in the patterns of menstrual hygiene practices and their sociodemographic determinants amongst adolescent girls and young women in India. The present study analyses data from the Indian National Family and Health Survey (NFHS), round 4 (2015–2016) and round 5 (2019–21). Women in the age group 15–24 years ($n = 241,180$) were interviewed regarding their menstrual hygiene practices. The proportion of women using sanitary napkins as absorbent during menstruation increased from 41.8% (NFHS-4) to 64.1% (NFHS-5), with more than six in ten adolescent girls and young women in India using sanitary pads during menses, although the socioeconomically vulnerable more likely to lack access. The higher age group (20–24 years), rural residence, lower wealth quintile, absence of schooling, absence of flush toilets, and lack of exposure to media were factors that were independently associated with the use of cloth as menstrual absorbent. Vaginal discharge was reportedly higher among women using unhygienic products, however, on adjusted analyses, no statistically significant association was observed with the type of absorbent used. The transition from cloth to sanitary pads has nearly doubled on average in the states implementing free and subsidised government pad distribution schemes during the same period.

Keywords: menstrual hygiene; menstrual health; reproductive tract infections; public health; health policy

Introduction

Menstruation is a physiological process characterised by the recurrent discharge of blood and mucosal tissue through the inner lining of the uterus into the vagina, which influences women's sexual, reproductive, and physical well-being ('About Menstruation | NICHD - Eunice Kennedy Shriver National Institute of Child Health and Human Development' 2017). Menstrual hygiene management (MHM) practices globally but especially in the developing world are influenced by local socio-cultural traditions that can adversely impact esteem, quality of life, and well-being ('About Menstruation | NICHD - Eunice Kennedy Shriver National Institute of Child Health and Human Development' 2017; Chandar *et al.* 2018). Ensuring safe MHM in adolescent girls and women requires access and utilisation of clean material for absorption of menstrual blood, privacy to change and dispose of the used material, and access to water, sanitation, and hygiene (WASH) facilities for cleaning the private parts ('Menstrual Health | JMP' [n.d.](#)). Achieving universal

menstrual health and hygiene (MHH) requires strengthening systemic factors driving MHM including awareness, social norms, advocacy, and policy factors ('Menstrual Hygiene' [n.d.](#)).

Menstrual hygiene materials are the products (absorbents) used to catch the menstrual flow including sanitary napkins or pads, menstrual cups, tampons, or cloth, with the use of traditional methods more common in developing countries. The fourth round of the National Family and Health Survey (NFHS-4) in 2015–16 reported 62.1% of women in the reproductive age group using clothes during their menstrual periods. According to the District Level Household Survey-4 (2012–13) in India, 37.6% of women used only cloth, 27.4% used sanitary napkins, and 2.3% used no menstrual hygiene material (Nitika and Lohani [2019](#)). The use of cloth was more common in women of rural areas and lower socioeconomic groups (Roy *et al.* [2021](#); Nabwera *et al.* [2021](#)). The use of unclean cloth, the re-use of cloth without washing and drying in sunlight due to social taboos, or the suboptimal frequency of changing sanitary pads due to access and affordability issues have been frequently reported (Chandar *et al.* [2018](#); Sarkar *et al.* [2017](#)). Furthermore, mothers themselves lacking understanding of appropriate menstrual health practices will fail to educate their daughters contributing to a vicious cycle of poor MHH (Sarkar *et al.* [2017](#); Upashe, *et al.* [2015](#)).

The use of unhygienic materials or the incorrect usage of sanitary products may increase the risk of reproductive and urinary tract infections. Studies from multiple parts of India have reported varying prevalence of reproductive tract infections (RTIs) ranging from 9.7% to 70.0% (Chaudhary *et al.* [2019](#); Sharma *et al.* [2018](#); Rathore *et al.* [2007](#); Kansal *et al.* [2016](#); Balakrishnan *et al.* [2022](#)). Several studies have also observed an association between the use of unhygienic menstrual absorbents and the burden of RTIs (Sharma *et al.* [2018](#); Balakrishnan *et al.* [2022](#); Das *et al.* [2015](#); Garg and Anand [2015](#); Torondel *et al.* [2018](#)) although most of these were limited in terms of sample size and population representativeness.

The promotion of menstrual health and hygiene globally especially in lower-middle-income countries (LMICs) is a major public health imperative ('Menstrual Hygiene Scheme (MHS) :: National Health Mission' [n.d.](#); 'Vikaspedia Domains' [n.d.](#); 'Menstrual Health and Hygiene' [n.d.](#)). In India, the government has introduced a MHS under the National Health Mission (NHM) to raise awareness about menstrual hygiene among adolescent girls, particularly in rural areas, increase access and utilisation of sanitary napkins, and provide adequate WASH and sanitary napkin disposal facilities in educational institutions. States and Union Territories across India are being funded to enable the decentralised purchase of sanitary napkins for their distribution at highly subsidised costs to adolescent girls and women in underprivileged communities ('Menstrual Hygiene Scheme (MHS):: National Health Mission' [n.d.](#)).

The present study analysed sequential rounds of a large nationally representative cross-sectional survey from India to assess the change in the patterns of menstrual hygiene practices and their sociodemographic determinants amongst adolescent girls and young women. The association between the use of menstrual hygiene materials and reproductive tract infections is also explored. To date, there has been no analysis to assess the correlation between free and subsidised sanitary pad/napkin distribution schemes of multiple state governments and their utilisation as the primary method for menstrual hygiene management by substitution of cloth and expected reduction in the burden of reproductive tract infections.

Methods

Data source

Present cross-sectional study utilised data from the Indian National Family and Health Survey (NFHS), round 4 (2015–2016) and round 5 (2019–21) ('National Family Health Survey' [n.d.](#)). This survey is carried out on a large scale in two phases, which cover a sample that is representative of households throughout India. It collects information on several indicators such as fertility, infant

and child mortality, family planning practices, maternal and child health, reproductive health, nutrition, anaemia, use and quality of health and family planning services, etc.

The NFHS-5 was completed in 707 districts selected from all 28 States and 8 Union Territories. Two-stage stratified sampling was employed using the 2011 census as the sampling frame. Each district was initially stratified into urban and rural areas. In the first stage, villages in rural regions and Census Enumeration Blocks in urban areas were chosen as primary sampling units (PSUs) using probability proportional to size sampling. Using a newly developed list of households that had been created by household mapping in the second stage, 22 households from each PSU were systematically chosen with an equal probability. In total, data were collected from 636,699 households and 724,115 women in the age group 15–45.

In NFHS-4, data were collected from 640 districts drawn from 29 states and 7 Union Territories. From 601,509 households, a total of 699,686 women between the ages of 15 and 49 were successfully interviewed.

The following outcomes were assessed in the present study:

1. Use of cloth as the preferred material during menstruation
2. Has the respondent experienced any genital discharge in the past 12 months?
3. Usage of sanitary, unsanitary, or both materials among adolescent girls in Indian states that provide free sanitary napkins for promoting menstrual hygiene among girls in the 10–19 age group under the NHM in India.

Dependent variables

Methods used for menstrual protection: Methods used for menstrual protection: In the NFHS questionnaire, women were asked whether they preferred cloth, locally prepared napkins, sanitary napkins, menstrual cups, tampons, others, or nothing to prevent bloodstains during menstruation. To study factors associated with cloth usage, the use of menstrual products was further classified into two categories – those using only cloth (coded as 1) and those using only hygienic products (coded as 0). Hygienic products included (any) locally prepared napkins, sanitary napkins, menstrual cups, or tampons. Further to the study association between the use of menstrual products and reproductive tract infection, menstrual product users were divided into three groups – unhygienic product users (cloth/others/nothing), hygienic product users (locally prepared napkins/sanitary napkins/menstrual cups/tampons), and those who used both. In the survey, inquiries pertaining to menstrual hygiene practices were directed solely to women within the age range of 15 to 24.

Reproductive tract infection: Reproductive tract infections (RTIs) include three types of infections: 1) sexually transmitted diseases (STDs), 2) endogenous infections, caused by an overgrowth of organisms normally present in the genital tract of healthy women, such as bacterial vaginosis or vulvovaginal candidiasis, and 3) iatrogenic infections, which may result from improperly performed medical procedures such as unsafe abortion or poor delivery practices ('Reproductive Tract Infections Reproductive Health Epidemiology Series Module 3', [n.d.](#)). Typical symptoms of RTI include – pain in the lower abdomen and pelvis, unusual or heavy vaginal discharge that may have an unpleasant odour, unusual vaginal bleeding, especially during or after sex or between periods, painful sex, fever, occasionally accompanied by chills, painful, frequent, or difficult urination ('Sexually Transmitted and Other Reproductive Tract Infections', [n.d.](#)). The NFHS does not directly record the presence of RTIs in women. However, within the NFHS module, women were queried to assess the presence of Sexually Transmitted Infections through a triad of questions: if she had a disease contracted through sexual contact, experienced a bad-smelling abnormal genital discharge, or had a genital sore or ulcer in the 12 months preceding the survey. The current study utilised the presence of vaginal discharge within the 12 months preceding the survey as a proxy indicator for RTIs, considering it is one of the commonly presented symptoms of RTIs and its widely acknowledged association with this class of infection ('Sexually Transmitted and Other Reproductive

Tract Infections', [n.d.](#); Chaudhary *et al.* 2019; Sharma *et al.* 2018; Kansal *et al.* 2016; Mehta, Parikh, and Bala, [n.d.](#); Ademas *et al.* 2020).

Independent variables

Sociodemographic characteristics: In the study, demographic and socioeconomic variables such as age (15-24/25-34/>34), place of residence, educational attainment, marital status, religion, ethnic group, employment status, and wealth index were considered.

Wealth index – Each person received a score that was generated using principal component analysis based on the number and types of consumer goods a household owns – from a television to a bicycle or car – as well as dwelling factors like the source of drinking water, bathroom facilities, and flooring materials. The score was then divided into five quintiles: poorest, poorer, medium, richer, and richest.

Mass media exposure: Women were asked how often they read newspapers, watched television, and listened to the radio. Their responses ranged from not at all to less than once per week, to at least once per week, to every day. Each variable was further divided into binary categories: no exposure (not at all)/exposure (less than once a week/at least once a week/every day). Finally, the degree of mass media exposure was derived as either complete exposure (Exposure to all 3 media), partial exposure (exposure to any one or two media), or none (exposure to none of the media).

History of sexual activity: Women were asked about their sexual history in the previous four weeks, and it was divided into three categories for analysis: never had sex/active/not active (not active in last 4 weeks-postpartum or no postpartum).

Sanitation and other hygiene-related practices during menstruation: For analysis, data on the availability of toilet facilities in the households were classified into No facility/Flush/pit/composite & others. Women were asked if they take baths during menstruation (Yes/No).

Distribution of sanitary napkins to adolescent girls: States were classified into two categories (Yes/No) based on whether they offer pads for free or at an affordable price to adolescent girls. Eight states in total provide free sanitary napkins in schools: Uttar Pradesh, Rajasthan, Maharashtra, Odisha, Chhattisgarh, Andhra Pradesh, and Kerala. Adolescent girls (rural) in Bihar receive Rs 300 as part of the Kishori Swasthya Yojana to purchase sanitary napkins (Jha 2022).

Statistical analysis

The sociodemographic characteristics of the women respondents in NFHS-4 and NFHS-5 were summarised using descriptive statistics after applying appropriate weights. Continuous variables are expressed in terms of mean (SD) or median (IQR) depending on the distribution, while categorical variables are presented in frequency and percentages. The use of various menstrual products in NFHS-5 and NFHS-4 was summarised using descriptive analysis with appropriate weights. All the analyses focused on women within the age range of 15 to 24 years.

To assess the factors associated with cloth usage and vaginal discharge (serving as a proxy measure for reproductive tract infection), respectively, only the NFHS 5 dataset was analysed. Univariable logistic regression followed by multivariable logistic regression was undertaken. The association between the use of sanitary or unsanitary menstruation products and vaginal discharge was further assessed by excluding women who reported having genital sores in the past 12 months from those who had vaginal discharge which could be suggestive of STD. P values less than 0.05 were considered statistically significant. All results are presented in terms of odds ratio (OR) and 95% confidence intervals (CIs).

Additionally, menstruation product utilization across states offering free sanitary napkins and those not offering, stratified by age - adolescent (15–19 years) and young women (>19–24 years), was examined. STATA, version 15.1, was used to compute all analyses.

Ethical considerations

The present study is the secondary data analysis of publicly available NFHS-4 and NFHS-5 data. The survey's participants voluntarily and knowingly gave their consent. The International Institute of Population Sciences' ethical review board granted the survey its ethical approval (IIPS).

Result

A total of 247,833 (NFHS-4) and 241,180 (NFHS-5) women in the 15–24 age group were interviewed regarding their menstrual hygiene practices (Figure 1). In the NFHS-4, the mean (SD) age of the women was 19.5 (2.9) years. Nearly two in three (67.9%) women lived in rural areas and four in five (79.1%) were Hindu by religion. Close to one-third of the surveyed women (31.9%) belonged to SC and ST groups. One in every ten women never attended school (10.3%). Nearly 59.0% of the women reportedly had never been in the union and only 14.9% were employed at the time of the survey. Around 62% of the surveyed women had access to toilets within their household. The sociodemographic profiles of the women surveyed in NFHS-5 were largely congruent with those observed in NFHS-4, except for a significant increase in the percentage of women with access to toilet facilities (81.1%) and a higher proportion who had completed higher levels of schooling. (Table 1)

The proportion of women using sanitary napkins as absorbent during menstruation exhibited a significant increase from 41.8% in NFHS-4 to 64.1% in NFHS-5. (Table 2) Further analysis was conducted using the NFHS-5 data to explore the factors associated with cloth usage, employing binary logistic regression followed by multivariable logistic regression. Among the women surveyed in NFHS-5, 55,450 women exclusively used cloth, while 114,111 exclusively relied on sanitary pads for menstrual management. On binary logistic regression, women aged 20–24 years, (cOR: 1.05; 95% CI: 1.03, 1.08), living in rural areas (cOR: 4.27; 95% CI: 4.09, 4.45), those belonging to socially disadvantaged communities, and those married (cOR: 1.76; 95% CI: 1.71, 1.81) or separated (cOR: 2.70; 95% CI: 2.24, 3.24) compared to younger women (15–19), those from urban region, belonging to non-SC/ST/OBC households, and never had been in union, respectively, had significantly higher odds of using cloth as menstrual absorbent material. Women with higher schooling were less likely to use cloth (cOR: 0.03; 95% CI: 0.03, 0.04) when compared to women with no schooling. Cloth use was also lowest in the richest quintiles (cOR: 0.03; 95% CI: 0.03, 0.04) although the odds of cloth usage were higher in working women (cOR: 1.46; 95% CI: 1.32, 1.61). Those women who did not have toilet facilities at home (cOR: 1.73; 95% CI: 1.65, 1.82) also had higher odds of using cloth. Women exposed to media partially or fully were less likely to use cloth compared to those who were not exposed to media at all.

All the exploratory variables that were significantly associated with cloth usage as menstrual absorbent ($p < 0.05$) in binary logistic regression were included in the adjusted regression model. After adjusting, the odds of cloth usage remained high in the 20–24 age group, rural regions, and women who were working. Similarly, higher schooling, higher wealth quintile, having flush toilets, and exposure to media were associated with reduced cloth usage. (Table 3)

Additionally, among the 485 women who reported not using any absorbent to prevent bloodstains during menstruation, a relatively higher proportion were from rural areas, had lower levels of education or none at all, were in the poorest wealth quintile, and lacked media exposure (Results are detailed in the supplementary table).

A total of 108,435 women in the 15–49 age group were surveyed on whether they experienced vaginal discharge in the previous 12 months, of which 6.9% ($n = 8,207$; 95% CI: 6.7, 7.1) women reported having such symptoms. Furthermore, among women aged 15 to 24, 3.6% ($n/N = 1,370/36,083$; 95% CI: 3.4, 3.9) reported a history of vaginal discharge in the preceding 12 months. On bivariable logistic regression, women using unhygienic menstrual absorbents were found to be 1.5 times more likely to experience vaginal discharge compared to those using hygienic menstrual absorbents (cOR = 1.53; 95% CI: 1.28, 1.83). Higher odds of vaginal discharge were also observed

Table 1. Sociodemographic Characteristics of the Women Respondents Aged 15 to 24 Years

	NFHS-4		NFHS-5	
	N = 247,833		N = 241,180	
	n	Col % (95%CI)	n	Col % (95% CI)
Age				
15–19	124,878	49.7 (49.4, 50.0)	122,480	50.6 (50.4, 50.9)
20–24	122,955	50.3 (50.0, 50.6)	118,700	49.4 (49.1, 49.6)
Area of residence				
Rural	179,374	67.9 (67.6, 68.2)	186,619	70.6 (70.3, 70.9)
Urban	68,459	32.1 (31.8, 32.4)	54,561	29.4 (29.1, 29.7)
Religion				
Hindu	182,356	79.1 (78.9, 79.4)	181,475	80.3 (80.1, 80.5)
Muslim	38,212	15.8 (15.6, 16.1)	33,773	15.2 (15.0, 15.5)
Christian	16,784	2.0 (1.9, 2.1)	15,802	2.1 (2.0, 2.1)
Others/no religion ^a	10,481	3.0 (2.9, 3.1)	10,130	2.4 (2.3, 2.5)
Caste				
	N = 237,647		N = 229,709	
SC & ST	90,541	31.9 (31.6, 32.1)	93,528	34.1 (33.9, 34.4)
OBC	99,215	45.5 (45.2, 45.8)	93,969	45.5 (45.2, 45.8)
Others/None of them	47,891	22.6 (22.3, 22.9)	42,212	20.4 (20.1, 20.6)
Education				
No schooling	26,627	10.3 (10.1, 10.4)	16,010	6.5 (6.4, 6.6)
Primary-secondary	186,190	73.5 (73.2, 73.8)	183,214	74.5 (74.2, 74.7)
Higher schooling	35,016	16.2 (16.0, 16.5)	41,956	19.0 (18.8, 19.2)
Wealth index				
Poorest	48,015	18.4 (18.2, 18.6)	52,954	20.1 (19.9, 20.3)
Poorer	56,529	21.2 (21.0, 21.4)	57,319	21.8 (21.6, 22.0)
Middle	54,350	21.5 (21.2, 21.7)	51,275	21.0 (20.8, 21.2)
Richer	48,054	20.7 (20.4, 20.9)	44,733	20.0 (19.8, 20.2)
Richest	40,885	18.3 (18.0, 18.5)	34,899	17.1 (16.8, 17.3)
Marital status				
Never in union ^b	152,116	59.0 (58.7, 59.2)	158,224	63.5 (63.3, 63.8)
Currently married	94,034	40.4 (40.1, 40.7)	81,557	35.9 (35.7, 36.2)
Separated ^c	1,683	0.6 (0.6, 0.7)	1,399	0.5 (0.5, 0.6)
Employment status				
	N = 42,912		N = 36,117	
Working	6,473	14.9 (14.4, 15.4)	5,359	13.8 (13.4, 14.3)
Not working	36,439	85.1 (84.6, 85.6)	30,758	86.2 (85.7, 86.6)
Type of toilet facility				
No toilet	92,656	38.0 (37.7, 38.2)	42,893	10.6 (10.4, 10.8)
Flush	117,306	49.0 (48.7, 49.3)	152,155	63.6 (63.3, 63.9)

(Continued)

Table 1. (Continued)

	NFHS-4		NFHS-5	
	N = 247,833		N = 241,180	
	n	Col % (95%CI)	n	Col % (95% CI)
Pit	22,404	6.8 (6.6, 6.9)	19,641	6.9 (6.8, 7.1)
Others ^d	15,467	6.2 (6.1, 6.4)	26,491	10.6 (10.4, 10.8)
Mass media exposure				
No exposure	41,191	15.7 (15.5, 15.9)	49,250	19.8 (19.6, 20.0)
Partial exposure	177,263	72.1 (71.9, 72.4)	169,080	70.9 (70.6, 71.1)
Full exposure	29,379	12.2 (12.0, 12.4)	22,850	9.3 (9.2, 9.5)

^aInclude Sikh, Jain, Buddhist, Parsi, Jewish, other, and those who reported no religion.

^bAlso include whose Gauna was yet to be done.

^cInclude all divorced/Separated/deserted/widowed women.

^dIncludes composting/hanging/bucket/dry toilets and others.

Table 2. Prevalence of Different Absorbents Usage During Menstruation in NFHS-5 & NFHS-4

Menstrual product	NFHS-4		NFHS-5	
	N = 247,833		N = 241,180	
	n	% (95% CI)	n	% (95% CI)
Cloth	162,890	62.1 (61.8, 62.4)	125,116	49.4 (49.2, 49.7)
Sanitary napkin	103,550	41.8 (41.5, 42.1)	152,294	64.1 (63.9, 64.4)
Locally prepared napkin	37,217	16.3 (16.0, 16.5)	35,511	14.9 (14.7, 15.1)
Others*	5,295	2.5 (2.4, 2.6)	5,513	2.2 (2.1, 2.3)
None	1,230	0.5 (0.4, 0.5)	485	0.2 (0.2, 0.2)

*Others include tampons, menstrual cups, and others. The NFHS-4 survey didn't include 'Menstrual cup' as a category, but it was introduced in NFHS-5.

among women in the higher age group (cOR = 4.40; 95% CI: 3.66, 5.28) those who lived in rural areas (cOR = 1.41; 95% CI: 1.16, 1.72), and those with no media exposure (cOR = 1.77; 95% CI: 1.28, 2.46). In addition, women with higher education levels (cOR = 0.31; 95% CI: 0.23, 0.40) and higher wealth quintiles (cOR = 0.78; 95% CI: 0.61, 0.99) had lower odds of experiencing vaginal discharge. However, when adjusted for all exploratory factors with a P value <0.05, the association between vaginal discharge and the type of menstrual absorbent used was not statistically significant. Further, women with a history of vaginal discharge who also had a recent history of genital sores (n = 438) were excluded from the analysis. While the use of sanitary products during menstruation initially appeared to have a protective effect in this subgroup, the association was not statistically significant after adjusting for potential confounders. (Tables 4 & 5)

The prevalence of sanitary and unsanitary menstrual absorbent use among adolescent girls and young women up to 24 years old was compared between states that had initiated government MHSs providing free sanitary napkins to school-going girls within the past five years with states that have yet to implement the scheme. Between NFHS 4 and NFHS 5, there was a marked decline in the percentage of women using unhygienic products and a notable rise in the percentage of women using hygienic products in states where free sanitary napkins were distributed, in contrast to states that had not yet introduced the programme. (Table 6)

Table 3. Factors Associated with Cloth Usage as a Preferred Absorbent to Prevent Staining During Menstruation in Women Aged 15 to 24 (NFHS-5, 2019–21)

	Total	Cloth	Hygienic product	Crude OR	Adjusted OR [£]
	Row % (95% CI)	Row % (95% CI)	Row % (95% CI)	cOR (95% CI)	aOR (95% CI)
	N = 169,561	n = 55,450	n = 114,111		
Age					
15-19	85,824	30 [29.6,30.4]	70 [69.6,70.4]	Ref	Ref
20-24	83,737	31.1 [30.7,31.5]	68.9 [68.5,69.3]	1.05 (1.03, 1.08)*	1.36 (1.22, 1.52)*
Area of residence					
Urban	41,905	12.9 [12.5,13.4]	87.1 [86.6,87.5]	Ref	Ref
Rural	127,656	38.8 [38.5,39.2]	61.2 [60.8,61.5]	4.27 (4.09, 4.45)*	1.64 (1.41, 1.90)*
Religion					
Hindu	128,542	30.4 [30.1,30.7]	69.6 [69.3,69.9]	2.76(2.51, 3.03)*	2.47 (1.86,3.28)*
Muslim	22,429	36.4 [35.6,37.3]	63.6 [62.7,64.4]	3.63(3.28, 4.01)*	3.77 (2.76, 5.16)*
Christian	11,012	17.5 [16.2,18.9]	82.5 [81.1,83.8]	1.34 (1.17, 1.53)*	1.59 (1.07, 2.35)*
Others/no religion ^a	7,578	13.6 [12.6,14.7]	86.4 [85.3,87.4]	Ref	Ref
Caste					
	N = 161,625				
SC & ST	65,868	36.4 [35.8,36.9]	63.6 [63.1,64.2]	2.25(2.15, 2.35)*	1.15 (0.98, 1.35)
OBC	64,962	31.1 [30.7,31.6]	68.9 [68.4,69.3]	1.78 (1.71, 1.86)*	1.32 (1.15, 1.53)*
Others/None of them	30,795	20.2 [19.6,20.8]	79.8 [79.2,80.4]	Ref	Ref
Education					
No schooling	11,880	74.7 [73.6,75.7]	25.3 [24.3,26.4]	Ref	Ref
Primary-secondary	126,431	32.4 [32.0,32.7]	67.6 [67.3,68.0]	0.16 (0.15, 0.17)*	0.36 (0.30, 0.43)*
Higher schooling	31,250	9.2 [8.8,9.6]	90.8 [90.4,91.2]	0.03 (0.03, 0.04)*	0.13 (0.10, 0.16)*
Wealth index					
Poorest	36,651	64.7 [64.1,65.4]	35.3 [34.6,35.9]	Ref	Ref
Poorer	37,276	43 [42.3,43.7]	57 [56.3,57.7]	0.41 (0.39, 0.42)*	0.52 (0.46, 0.59)*
Middle	35,077	25.2 [24.6,25.8]	74.8 [74.2,75.4]	0.18 (0.17, 0.19)*	0.29 (0.25, 0.33)*
Richer	32,559	14.4 [13.9,14.9]	85.6 [85.1,86.1]	0.09 (0.08, 0.09)*	0.18 (0.15, 0.21)*
Richest	27,998	5.7 [5.3,6.1]	94.3 [93.9,94.7]	0.03(0.03, 0.04)*	0.09 (0.07, 0.11)*
Marital status					
Never in union ^b	110,775	26 [25.6,26.3]	74 [73.7,74.4]	Ref	Ref
Currently married	57,797	38.3 [37.7,38.8]	61.7 [61.2,62.3]	1.76 (1.71, 1.81)*	1.00 (0.89, 1.12)
Separated ^c	989	48.7 [44.1,53.2]	51.3 [46.8,55.9]	2.70 (2.24, 3.24)*	1.06 (0.64, 1.76)
Employment status					
	N = 25,308				
Not working	21,495	29.9 [29.1,30.7]	70.1 [69.3,70.9]	Ref	Ref
Working	3,813	38.5 [36.3,40.6]	61.5 [59.4,63.7]	1.46 (1.32, 1.61)*	1.26 (1.11, 1.43)*

(Continued)

Table 3. (Continued)

	Total	Cloth	Hygienic product	Crude OR	Adjusted OR [£]
	Row % (95% CI)	Row % (95% CI)	Row % (95% CI)	cOR (95% CI)	aOR (95% CI)
	N = 169,561	n = 55,450	n = 114,111		
Type of toilet facility					
No toilet	30,160	54.5 [53.8,55.2]	45.5 [44.8,46.2]	1.73 (1.65,1.82)*	0.98 (0.83, 1.15)
Flush	109,024	21.5 [21.2,21.8]	78.5 [78.2,78.8]	0.39 (0.38,0.41)*	0.80 (0.68, 0.940)*
Pit	13,231	36.3 [35.2,37.5]	63.7 [62.5,64.8]	0.82 (0.77, 0.88)*	0.80 (0.64, 1.00)
Others ^d	17,146	40.8 [39.8,41.8]	59.2 [58.2,60.2]	Ref	Ref
Mass media exposure					
No exposure	35,338	62.3 [61.6,63.0]	37.7 [37.0,38.4]	Ref	Ref
Partial exposure	118,847	23.6 [23.3,23.9]	76.4 [76.1,76.7]	0.18 (0.18, 0.19)*	0.49 (0.44, 0.54)*
Full exposure	15,376	15.9 [15.1,16.6]	84.1 [83.4,84.9]	0.11 (0.10, 0.12)*	0.48 (0.39, 0.59)*

Estat gof = 0.96; *Indicates p values <0.05;

[£]Adjusted for all the variables that were statistically significant with a P value <0.05 in bivariable logistic regression.

^aInclude Sikh, Jain, Buddhist, Parsi, Jewish, other, and those who reported no religion.

^bAlso include whose Gauna was yet to be done.

^cInclude all divorced/Separated/deserted/widowed women.

^dIncludes composting/hanging/bucket/dry toilets and others.

Discussion

The present study findings based on the largest nationally representative demographic and health surveys in India observed nearly a one-third increase in the proportion of women (15–24 years) using modern hygienic sanitary products during menstruation between NFHS-4 (2015–16) and NFHS-5 (2019–21). Furthermore, in this study, lower educational status was a predictor of the non-utilisation of sanitary pads, which corroborates evidence from previous studies (Chauhan *et al.* 2021; Garg *et al.* 2022).

However, the burden of vaginal discharge suggestive of reproductive tract infections amongst adolescent girls and young women in India did not differ significantly between the sanitary pads and cloth users on adjustment for potential confounders. Previous studies in India comparing the use of sanitary napkins versus cloth during menstruation and the susceptibility to reproductive tract infections (RTIs) have shown mixed results. A study done on 619 school-going girls in South India observed those with low menstrual hygiene index had a higher likelihood of having symptoms of white discharge (Narayan *et al.* 2001). In contrast, a study conducted from a low-income urban agglomerate in Northern India did not detect a statistically significant difference in self-reported vaginal discharge between women who used sanitary napkins and those who used fresh cloths or homemade pads (Singh *et al.* 2001). Similar findings were reported from a study in Tanzania, where there was no discernible difference between cloth and sanitary napkin users in terms of the prevalence of bacterial vaginosis (Baisley *et al.* 2009). Another study conducted in Bangladesh found that women who do not maintain good hygiene during menstruation have higher odds of developing a reproductive tract infection (Wasserheit *et al.* 1989). A study in Gambia, on the other hand, found no association between bacterial vaginosis and menstrual hygiene (Demba *et al.* 2005). A possible reason for the lack of significant reduction of RTI symptoms despite the adoption of sanitary pads as observed in the present study may be a function of behavioural determinants in a multifactorial causal pathway. Makeshift cloth pads when reused in low-income LMIC settings possibly increase the risk of infection when they are reused without washing, cleaning, and drying indoors instead of out in the sunlight due to stigma-

Table 4. Prevalence of Vaginal Discharge and its Determinants in Women Aged 15 to 24 (NFHS-5, 2019–21)

	Total	Vaginal discharge Present	Crude OR	Adjusted OR
		Row % (95% CI)	cOR (95% CI)	aOR (95% CI)
	N = 36,054 ^a	n = 1,370		
Menstrual absorbent*				
Unhygienic	8,543	4.3 [3.8,4.9]	1.53 (1.28, 1.83)*	1.16 (0.95, 1.43)
Hygienic	17,029	2.9 [2.6,3.2]	Ref	Ref
Both hygienic and unhygienic product	10,482	4.3 [3.8,4.8]	1.51 (1.27, 1.80)*	1.36 (1.13, 1.63)*
Age				
15–19	18,218	1.4 [1.2,1.6]	Ref	Ref
20–24	17,836	5.9 [5.4,6.3]	4.40 (3.66, 5.28)*	1.18 (0.95, 1.47)
Area of residence				
Urban	8,158	2.8 [2.4,3.4]	Ref	Ref
Rural	27,896	3.9 [3.6,4.2]	1.41 (1.16, 1.72)*	1.08 (0.86, 1.35)
Religion				
Hindu	26,954	3.5 [3.2,3.8]	Ref	
Muslim	5,120	4.2 [3.5,5.0]	1.22 (0.99, 1.50)	–
Christian	2,336	3.2 [2.0,4.9]	0.91 (0.57, 1.44)	
Others/no religion	1,644	4.4 [3.2,6.0]	1.29 (0.92, 1.81)	
Caste				
	N = 34,358			
SC & ST	13,981	3.8 [3.3,4.2]	1.12 (0.90, 1.40)	–
OBC	14,120	3.6 [3.2,4.0]	1.07 (0.86, 1.33)	
Others/None of them	6,257	3.4 [2.8,4.0]	Ref	
Education				
No schooling	2,439	7.4 [6.2,8.7]	Ref	Ref
Primary-secondary	27,229	3.6 [3.3,3.9]	0.47 (0.39, 0.57)*	0.80 (0.64,1.00)
Higher schooling	6,386	2.4 [1.9,2.9]	0.31 (0.23, 0.40)*	0.65 (0.48,0.88)*
Wealth index				
Poorest	7,759	3.8 [3.2,4.4]	Ref	Ref
Poorer	8,687	4.2 [3.6,4.8]	1.10 (0.89, 1.37)	1.20 (0.95, 1.51)
Middle	7,758	3.8 [3.3,4.4]	1.00 (0.8, 1.26)	1.18 (0.91, 1.53)
Richer	6,698	3.0 [2.5,3.5]	0.78 (0.61, 0.99)*	1.05 (0.79, 1.40)
Richest	5,152	3.1 [2.6,3.7]	0.81 (0.63, 1.04)	1.45 (1.05, 1.99)*
Marital status				
Never in union	23,669	0.5 [0.4,0.6]	Ref	Ref
Currently married	12,166	9.0 [8.4,9.7]	21.1 (16.1, 27.6)*	18.78 (13.75, 25.65)*

(Continued)

Table 4. (Continued)

	Total	Vaginal discharge Present	Crude OR	Adjusted OR
		Row % (95% CI)	cOR (95% CI)	aOR (95% CI)
	N = 36,054 ^a	n = 1,370		
Separated	219	9.7 [5.6,16.3]	22.9 (12.0, 43.8)*	20.60 (10.61, 39.98)*
Type of toilet facility				
No toilet	22,693	3.4 [3.1,3.8]	Ref	
Flush	2,901	3.9 [2.9,5.1]	0.94 (0.78, 1.13)	
Pit	6,419	3.6 [3.1,4.2]	1.07 (0.77, 1.49)	–
Others	4,041	4.5 [3.8,5.3]	1.25 (0.98, 1.58)	
Mass media exposure				
No exposure	7,346	4.3 [3.7,4.9]	1.77 (1.28, 2.46)*	0.92 (0.65, 1.31)
Partial exposure	25,324	3.6 [3.3,3.9]	1.48 (1.09, 2.01)*	1.09 (0.80, 1.48)
Full exposure	3,384	2.4 [1.8,3.2]	Ref	Ref
Sexual activity				
Never had sex	24	0	Empty	
Active in the last 30 days	9.3	9.3 [8.5,10.1]	0.98 (0.83, 1.15)	–
Not active in the last 30 days	4,359	9.5 [8.4,10.6]	Omitted	
Take a bath during menstruation				
	N = 33,256			
No	1,845	3.6 [2.6,5.1]	1.10 (0.77, 1.60)	–
Yes	31,411	3.3 [3.0,3.6]	Ref	

^a(n = 29) observations were recorded as 'do not know' and were excluded from the analyses; Estat gof = 0.18;

*Indicates p-value <0.05.

related concerns. Furthermore, suboptimal frequency of replacement of disposable sanitary pads during menses or mixed napkin and cloth usage due to poor awareness or unmet need for menstrual hygiene material has been frequently observed in LMICs particularly amongst women from low socioeconomic backgrounds (Garg *et al.* 2022; Smith *et al.* 2020).

National public health policy in India prioritises menstrual hygiene promotion in adolescent girls and women through the implementation of the MHSMHS under the aegis of the landmark NHM through which funds are allotted to state governments for the decentralised purchase of sanitary napkin packs for distribution to beneficiaries. To date, the MHS for free pad distribution in schools and through subsidised rates in urban poor communities has already been implemented in 9 States and Union Territories in India (India. Ministry of Drinking Water and Sanitation 2015). This analysis suggests that states implementing the MHS within the past five years have reduced by half the prevalence of unhygienic menstrual absorbent amongst adolescent girls and young women (15–24 years) compared to non-MHS implementing states.

The present study has certain important policy implications. First, the use of sanitary napkins in India has increased by a third in the past five years driven among other factors by government impetus on the distribution of free or subsidised pads in the most vulnerable populations.

Table 5. Association Between Use of Menstrual Absorbents and Vaginal Discharge Excluding Women with Genital Sores

Menstrual absorbents	Vaginal discharge present (n = 932)	
	Crude OR (95% CI) P value	Adjusted OR ^a (95% CI) P value
Unhygienic	1.48 (1.19, 1.84) <0.001	1.22 (0.94, 1.57) 0.120
Hygienic	Ref	Ref
Both	1.43 (1.16, 1.77) 0.001	1.32 (1.05, 1.64) 0.013

^aAdjusted for variables including age, education, area of residence, wealth index, marital status, and media exposure.

Table 6. Prevalence of Menstrual Absorbents Usage by Indian States Providing Free Sanitary Napkins Among Adolescent School-Going Girls

	NFHS-5		P-value	NFHS-4		P-value
	Distribution	No distribution		Distribution	No distribution	
	N = 290,735	N = 433,380		N = 295,998	N = 403,688	
	% (95%CI)			% (95%CI)		
Adolescent (15–19)	n = 54,953	n = 67,527		n = 58,175	n = 66,703	
Unhygienic	24.5 [24.1,24.8]	21.2 [20.8,21.5]		51.2 [50.7,51.6]	33.5 [33.1,33.9]	
Hygienic	45.6 [45.1,46.0]	54.3 [53.9,54.7]		23.6 [23.2,23.9]	43.7 [43.3,44.1]	
Both	30 [29.6,30.4]	24.5 [24.1,24.9]	<0.001	25.3 [24.9,25.7]	22.8 [22.4,23.1]	<0.001
Young women (>19–24)	n = 50,555	n = 68,145		n = 53,714	n = 69,241	
Unhygienic	26 [25.6,26.4]	23 [22.6,23.3]		48.6 [48.1,49.0]	36.3 [36.0,36.7]	
Hygienic	44 [43.5,44.5]	52.7 [52.3,53.1]		24.8 [24.4,25.2]	41.4 [41.0,41.9]	
Both	30 [29.6,30.5]	24.3 [24.0,24.7]	<0.001	26.6 [26.2,27.0]	22.2 [21.9,22.6]	<0.001

Nevertheless, a previous study from Delhi conducted in low-income urban resettlement colonies observed that women of low socioeconomic status often switch to using cloth if they lack access to pads which suggests the critical dependence of women on this scheme to fulfil their menstrual hygiene needs (Garg *et al.* 2022). Factors such as the push to accelerate sanitation coverage through improved WASH facilities, especially in rural India, may also have increased the acceptability of modern menstrual absorbents; however, the present study could not determine a causal association. Second, the expansion in the use of healthy sanitary methods does not correlate with a significant reduction in the burden of reproductive tract infections, which suggests that menstrual health campaigns in India should focus on the message of correct frequency of changing pads apart from the advantage in reducing staining and avoiding missing school or work during menses ('Akshay Kumar Lends Support to New Campaign on Menstrual Hygiene' 2018; Austrian *et al.* 2021). Third, the public health ethics of massively advancing sanitary pad use in India through large-scale government intervention and subsidies are currently lacking, especially in the absence of an evaluation of the cost-effectiveness of the free pad schemes. Even if sanitary pads are an essential public health good that should be made universally affordable and available to women, the associated environmental implications and concerns arising from the inadequate availability of used sanitary napkin disposal facilities in India also co-exist as a major public health challenge. The NFHS provides crucial data on various aspects of public health, including women's health. However, the

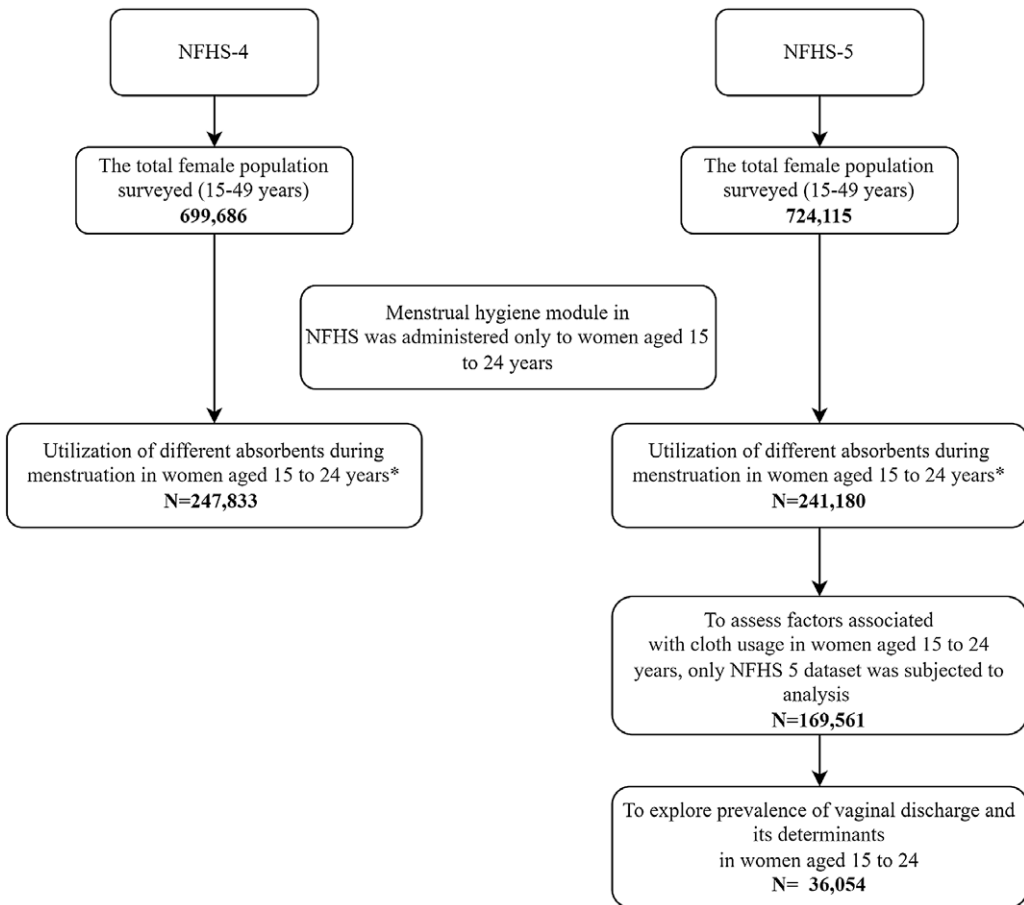


Figure 1. Study Participants Included in Analyses. * Utilization of different menstrual absorbents was captured through multiple choice question.

existing NFHS interview schedule does not capture information on how women dispose of used menstrual pads, which may be collected through relevant questions in future rounds of the NFHS. Furthermore, water scarcity is a well-established factor contributing to poor menstrual hygiene in LMICs (Patel *et al.* 2022). However, in the NFHS, only drinking water accessibility was assessed in the participants, which precluded incorporating the variable in the current model.

There are certain study limitations. The extent of improvement in menstrual hygiene knowledge and attitudes in the participants could not be assessed because no such data was captured in the survey. Like other demographic and health surveys in LMICs, specific questions that measured the extent of fulfilment of menstrual material needs were not queried (Smith *et al.* 2020).

Furthermore, in this analysis, cloth use during menstruation was considered unsanitary since information on the mode of its utilisation was lacking although cloth pads that are correctly applied and dried prior to reuse are safe and protective against infections (Daher *et al.* 2022). Information on menstrual hygiene beliefs and practices, source of pad access and barriers, and the associated costs and affordability was not collected in this survey, which precluded evaluation of the perceived usefulness and current shortcomings of the MHS for women in India. Finally, this analysis relied on self-reported vaginal discharge alone rather than clinical confirmation for defining RTI, which may have resulted in an underestimation of the true burden and determinants of RTI in the participants.

In conclusion, more than six in ten adolescent girls and young women in India use sanitary pads during menses with significantly reduced utilisation in those without schooling, living in

rural areas, and belonging to comparatively poorer wealth quintiles. The increase in sanitary pad use coverage increased by one-third between NFHS-4 (2015–16) and NFHS-5 (2019–21) with the pace of switch from cloth to pad doubling on average in the states implementing free pad distribution schemes during the same period. However, there was only a small reduction in the prevalence of vaginal discharge in the respondents with no statistically significant association observed with the type of absorbent used suggesting only limited applicability in real-world control of reproductive tract infections.

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