Waterlines, 38:2, 94–112
<http://dx.doi.org/10.3362/1756-3488.18-00032>

Menstrual hygiene management and reproductive tract infections: a comparison between rural and urban India

Alejandra Almeida-Velasco and Muthusamy Sivakami

Abstract: *The objective of the research was to compare factors associated with menstrual hygiene management (MHM) between urban and rural ever-married women in India, and its effect on reproductive tract infections (RTIs). A cross-sectional study was performed analysing data from the Indian District Level Household and Facility Survey 2007–08 (DLHS-3). The respondents were ever-married women between 15 and 49 years of age (N = 577,768). A quarter of women from urban areas use improved methods compared with only 4.3 per cent in rural areas. Cloth had the highest prevalence of usage in both areas. Socio-demographic factors associated with the usage of improved methods were almost the same between localities. Women using improved methods were less likely to suffer from RTIs across localities, except for urinary tract infections (UTIs) in rural areas; UTIs (adjusted odds ratio (AOR) = 0.95 – 1.03 in rural areas and AOR = 0.80 – 0.88 in urban areas). Findings reiterate the complexity of MHM and the need for immediate attention from the government and other agencies to ensure that girls and women have hygienic practices during their menstrual periods which will help prevent RTIs related to poor MHM.*

Keywords: menstrual, hygiene, rural, urban, ever-married

Menstruation is a female physiological cycle, characterized by bleeding from the uterus through the vagina (Guyton and Hall, 2006; Aniebue et al., 2009). Globally, 52 per cent of females are of reproductive age (House et al., 2013). Many girls in low and middle income countries (LMICs) start menstruating not knowing about it and without adequate facilities to properly manage it (Sumpter and Torondel, 2013). The situation is even less favourable in rural areas (Thakre et al., 2012; Paria et al., 2014; Das et al., 2015).

During the menstrual period, it is important for women to keep their genitalia clean (Paria et al., 2014). In many parts of the world, including India, misconceptions and taboos around menstruation have a negative impact on appropriate menstrual hygiene management (MHM) (House et al., 2013). Education, culture, and socioeconomic characteristics play significant roles in menstrual sanitation (Paria et al., 2014). For proper MHM, women must have access to clean water, absorbents, proper facilities to change, and the ability to clean themselves (House et al., 2013).

Alejandra Almeida-Velasco MD (alealmeidavelasco@gmail.com) Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden; Muthusamy Sivakami MA, PhD (sivakami@tiss.edu) School of Health Systems Studies, Tata Institute of Social Sciences, Mumbai, Maharashtra, India
© The authors. This open access article is published by Practical Action Publishing and distributed under a Creative Commons Attribution Non-commercial No-derivatives CC BY-NC-ND license http://creativecommons.org/licenses/by-nc-nd/4.0/ ISSN: 0262-8104/1756-3488

Copyright

Facilities like toilets and water are important to enable women to conduct their everyday activities (Sommer et al., 2016). When MHM needs are unmet, women and girls are more susceptible to reproductive tract infections (RTIs) (Khanna and Bhawsar, 2005; Auemaneekul et al., 2013; Paria et al., 2014; Anand et al., 2015; Das et al., 2015; van Eijk et al., 2016). There are three ways to contract an RTI: 1) sexually transmitted (STIs); 2) from overgrowth of organisms normally present in the reproductive tract; and 3) associated with medical procedures such as abortion (Rabiu et al., 2010). The RTIs commonly found associated with inappropriate MHM are bacterial vaginosis (BV), candidiasis, and urogenital tract infections. BV and candidiasis are not sexually transmitted vaginal infections, characterized by vaginal discharge. BV is produced by an imbalance in the vaginal bacteria and candidiasis by a yeast infection. UTIs are caused by pathogens getting from the urethra to the bladder; pain while urinating is a common symptom. Studies have shown the associations between unhygienic MHM practices and the development of RTIs (McCathie, 2006; Dielubanza and Schaeffer, 2011; Salvatore et al., 2011). Women with poor MHM are three times more likely to have RTIs than women with proper MHM (Khanna and Bhawsar, 2005; Paria et al., 2014). Other studies showed that unimproved methods of MHM are correlated with symptoms of RTIs such as itching of the vulva, pain during urination, and vaginal discharge (Anand et al., 2015). It is hypothesized that bad hygiene practices cause moist genitals, leading to opportunistic infections (Das et al., 2015).

Despite the health implications, poor MHM has remained a neglected subject in most LMICs, now emerging as a global health issue (Sommer et al., 2015, 2016; Dutta et al., 2016). School absenteeism related to menstruation was one important issue placing MHM on the global agenda (Sommer et al., 2015; Phillips-Howard et al., 2016). Absenteeism has been strongly correlated with menstruation as schools often lack facilities which allow girls to practice hygienic menstrual management. The poor availability of absorbents has been pointed out as a reason for not attending school (Mahon and Fernandes, 2010). Results from 64 studies conducted in India reported that one out of four girls miss school during menstruation (van Eijk et al., 2016). In Nepal, half of the women interviewed in a study reported not going to school during their menstruation period due to the lack of proper spaces to wash themselves (Auemaneekul et al., 2013). A study from Kenya found a link between dropping out of school and menstruation (McMahon et al., 2011). Addressing this problem from all perspectives is not only necessary but urgent to avoid the negative consequences it has on women and girls around the globe. In 2014, UNICEF and Columbia University convened a meeting, 'MHM in Ten', to create strategies to overcome the barriers menstruation imposes on girls. These include involving governments in promoting MHM and allocating resources to improve MHM (UNICEF, 2015).

In India, 67.25 per cent of the population live in rural areas (World Bank, n.d.) and about 28 per cent of the total population (approximately 1.3 billion) are women of reproductive age (CIA, n.d.). Around 85 per cent of ever-married women still do not use improved methods to manage menstrual blood (Anand et al., 2015). Poor MHM contributes to the high prevalence of RTIs and morbidity in India (Garg et al., 2012). In 2015 the government of India released the *MHM National Guidelines*, recognizing the importance of MHM for overall wellbeing of girls and women and to address and overcome problems associated with poor MHM (Kaiser, 2015).

Copyright

Emory University's ecological framework has been postulated to understand the multidimensional factors in the aetiology of MHM. This approach organizes factors which influence MHM into five levels: biological; personal; interpersonal; environmental/resource availability; and societal/government policy (Long et al., 2013; Dutta et al., 2016). However, it does not consider how improper menstrual hygiene can lead to RTIs (vaginal discharge/UTIs). Therefore, MHM and its association with RTIs was identified as an important research gap in the literature (Anand et al., 2015; Das et al., 2015).

The aim of this study is to understand the differences between rural and urban ever-married women in India concerning MHM, and how MHM relates to RTIs in both. Identifying any differences will help create a more comprehensive approach towards MHM and RTIs, especially in LMICs.

Methodology

Data was used from the District Level Household and Facility Survey (DLHS-3), a cross-sectional, nationwide survey conducted in India during 2007–2008 (IIPS, 2010). The DLHS-3 included women aged 15 to 49 years and used two questionnaires; a household questionnaire which collected information from all members in the household and an ever-married questionnaire, collecting information related to women's characteristics and maternal and reproductive health, including information on MHM. The questionnaires were bilingual, with questions in the regional language and English, and were administered through face-to-face interviews. A total of 720,320 households with 643,944 ever-married women 15 to 49 years old were interviewed. The response rates for the household and ever-married questionnaire were 94 per cent and 89 per cent respectively (IIPS, 2010). The present study utilized data relating to MHM from 577,768 women who were in the reproductive period of their lives (post-pubescent and pre-menopause). The data used for the analysis was the most recent data available with information on MHM for the whole country using nationally representative data with systematic random sampling until very recently. Only very few studies have taken advantage of this data set to understand the issues around MHM.

Outcome variables

This study examined whether rural and urban settings had differences regarding MHM and self-reported symptoms of RTIs (vaginal discharge/UTIs). It was carried out in two parts. The first part explored the relationship between using different types of menstrual absorbents and respondents' socio-demographic characteristics. The second part tested whether the absorbents used were associated with self-reporting symptoms of RTIs, and to identify other factors linked to RTIs in relation to MHM between rural and urban areas.

Respondents were classified based on the absorbents they used. Locally prepared napkins and sanitary napkins were classified as improved methods. Cloth, nothing, and others were considered unimproved, including women who use a combination of hygienic and unhygienic methods.

Copyright

Women were asked whether they had had any abnormal vaginal discharge in the last three months; a positive response was considered to have a vaginal discharge problem. Those who had experienced any of the following symptoms in the last three months – itching or irritation over vulva, pain in lower abdomen, pain on urination or defecation, swelling in the groin, or low backache – were considered to have a UTI.

Independent variables

Most of the variables were chosen and grouped using the Emory ecological framework (Dutta et al., 2016). This framework does not consider the relationship between MHM and RTIs; these variables were identified from additional literature research (Anand et al., 2015; Das et al., 2015):

- biological category: age (continuous, in years);
- personal category: level of education (non-literate/1–5 years/6–8 years/9 years and above), and heard or seen a message of personal hygiene (yes/no);
- interpersonal category: awareness of RTI/STI (yes/no), and heard or seen a message of hygiene from friends (yes/no);
- environmental category: type of toilet facility (improved/unimproved);
- societal category: religion (Hindu/Muslims/others), caste (Scheduled Tribe or Caste/other caste/no caste), wealth index (poorest, poor/middle/rich, richest).

Other categories guided by literature were:

- age at marriage (continuous, in years);
- marital status (currently married/married but *gauna* (a ceremony performed when the bride starts living with the groom) not performed, separated, deserted, divorced, and widowed);
- reproductive category: total pregnancies (no pregnancy/1–3/4 and above), induced abortions (no abortion/1–2/3 and above), spontaneous abortion (no abortion/1–2 abortions/3 and above), contraceptives (barrier/hormones/intrauterine/sterilization/traditional and others).

Wealth index measured the economic status by combining household amenities, assets, and durables which was computed at a national level and divided into quintiles. DLHS-3 had five quintiles; this study used three categories, poor, middle, and rich, for the analysis.

In-depth statistical analyses of ever-married women 15–49 years old

Descriptive statistics on socio-demographic characteristics were computed as means and standard deviation (SD) for continuous variables, and frequencies for categorical variables. A bivariate analysis was conducted to explore the relationship between each independent variable and the outcome variable. Variables associated with the outcome at a significance of $p<0.05$ were used in the subsequent multivariate logistic regression models. The first logistic model tested the association between socio-demographic factors and MHM among respondents from rural and urban settings.

Copyright

A second logistic regression model was carried out to test the relationship between the socio-demographic factors and absorbents used and RTIs. Results with a p-value ≤0.05 were considered statistically significant. Odds ratios (OR) and 95 per cent confidence intervals (CI) were provided. The analysis was adjusted for confounding factors such as age, education, religion, wealth index, marital status, toilet facilities, and access to information. The variables 'total pregnancies', 'induced abortion', and 'spontaneous abortion' had 0.9 per cent of missing data. Missing data were excluded from the analysis. The data were analysed using Statistical Package for Social Science (SPSS) software version 23.

Ethical considerations

DLHS-3 received ethical approval from the Ethics Review Board of the International Institute for Population Sciences (IIPS), and adhered to ethical recommendations made by the World Health Organization (WHO). Informed consent was obtained from all respondents. Parental consent was obtained for women under 18 years old. The participants were informed about their right to refuse to answer or withdraw their participation at any time. Information collected was kept secure and confidential. Interviewers received training before the data collection and women were interviewed by female interviewers. The data set is available in the public domain.

Results

Table 1 provides the background characteristics of the study population. The mean age for women living in rural areas was 30.2 (SD 7.9) and urban areas 31.8 (SD 7.6). Overall, more than three-quarters of the respondents were from rural areas. Half of the women in rural areas were not literate, contrasting with almost half (46.2 per cent) of women in urban areas who reported nine or more years of education. Hinduism was the prevailing religion, followed by Islam. In rural areas, 38.5 per cent belong to Scheduled Caste/Scheduled Tribe (SC/ST), 23.2 per cent to other caste, and 38.4 per cent had no caste. In urban areas, 23.1 per cent belong to SC/ST, 35.9 per cent to other caste, and the remaining 40.9 per cent had no caste. About 44 per cent of the people living in rural areas belonged to the poorest and poor strata, contrasting with the urban settings where 6.6 per cent reported belonging to those strata. Improved toilets were more common in urban (75 per cent) than in rural (26 per cent) areas.

Usage of improved methods

About 24 per cent of women from urban areas reported using improved methods compared with 4.3 per cent in rural areas. Cloth was the absorbent used by the majority of women overall: 93.8 per cent in rural settings and 75.8 per cent in urban settings.

In both localities, among women 15 to 34 years old (rural 10.2 per cent, urban 47.6 per cent) improved methods were slightly more prevalent than for older women (rural 6.9 per cent, urban 42.9 per cent). Education impacted positively on hygienic practices which increased with increased years of education. Improved methods were

Copyright

Table 1 Background characteristics of the study population (N = 577,768)

Socio-demographic characteristics	*Rural (n = 452,817)*		*Urban (n = 124,951)*	
	%	n	%	n
Biological				
Age Mean (Standard Deviation) 30.5±7.9				
Personal				
Years of education				
Non-literate	50.8	230,051	23.8	29,717
1–5	16.7	75,684	13.0	16,378
6–8	14.3	64,591	17.0	21,186
9 and above	18.2	82,491	46.2	57,670
Heard/seen message about personal hygiene				
No	20.0	90,499	8.1	10,062
Yes	80.0	362,318	91.9	114,889
Interpersonal				
Awareness of RTI/STI				
No	71.3	322,989	56.8	71,017
Yes	28.7	129,828	43.2	53,934
Hygiene message from friends				
No	44.9	203,446	42.4	52,986
Yes	55.1	249,371	57.6	71,965
Environmental				
Toilet facility[1]				
Unimproved	74.0	335,020	25.0	31,222
Improved	26.0	117,797	75.0	93,729
Societal				
Religion				
Hindu	78.4	354,951	73.4	91,688
Muslims	10.2	46,047	16.5	20,661
Others	11.4	51,819	10.1	12,602
Caste				
SC/ST	38.5	174,157	23.1	28,894
Other castes	23.2	104,933	35.9	44,894
No caste	38.3	173,727	41.0	51,163
Wealth index				
Poorest/poor	44.3	200,491	6.6	8,270
Middle	23.3	105,337	10.4	12,954
Richer/richest	32.4	146,900	83.0	103,703

(Continued)

Copyright

Table 1 Continued

Socio-demographic characteristics	*Rural (n = 452,817)*		*Urban (n = 124,951)*	
	%	n	%	n
Others				
Age at first marriage				
Mean (Standard Deviation) 17.5±3.8				
Marital status				
Not currently married	5.4	24,424	5.3	6,666
Currently married	94.6	428,393	94.7	118,285
Reproductive information				
Total pregnancies				
No pregnancy	10.2	45,511	9.3	11,571
1–3	55.5	248,749	65.1	81,126
4 and above	34.3	153,875	25.6	31,909
Induced abortions				
No abortion	97.4	436,776	95.1	118,466
1–3	2.4	10,572	4.6	5,740
3 and above	0.2	747	0.3	370
Spontaneous abortion				
No abortion	90.4	405,098	88.8	110,587
1–3	8.9	39,828	10.3	12,933
3 and above	0.7	3,151	0.9	1,079
Contraceptive methods				
Sterilization	67.5	149,226	57.2	41,745
IUD	2.8	6,178	5.0	3,633
Hormones	8.3	18,458	7.9	5,755
Condom[2]	7.4	16,428	17.2	12,588
Traditional	14.0	30,887	12.7	9,263

Note: [1]Toilet facilities: improved = flush to piped sewer systems, flush to septic tank, flush don't know where, ventilate improved pit, pit latrine with slab, twin pit; unimproved = flush somewhere else, pit latrine without slab, dry toilet, no facilities uses open space, other
[2]Includes female condom. Female condom and male condom are classified as contraception barrier methods

more prevalent among women who identified as Christian, Buddhist, Jewish, Jain, Parsi, Sikh, or not having any religion (grouped as 'others') compared with women who identified as Hindu or Muslim. With respect to the caste, being from 'other castes' reported higher use of improved methods than being from 'SC/ST' and 'no caste' in both settings. Access to proper toilet facilities has been recognized as an important factor for MHM. Access to improved toilets resulted in higher proportions of women using hygienic methods; 11.5 per cent in rural areas and 29.1 per cent in

Copyright

urban areas. As wealth index increased, the usage of improved methods increased in both localities. Across all variables, the proportion of women using improved methods was larger in urban than rural areas. Nevertheless, the proportion of women using improved methods remains very low in all areas in India.

Multivariable logistic regression

Factors associated with hygienic practices stratified by localities. In both rural and urban localities younger women were more likely to use improved methods than older women (see Table 2); (adjusted odds ratio (AOR) = 0.97, CI 0.97–0.98 in rural and AOR = 0.99, CI 0.99–0.99 in urban). Schooling was a strong predictor in both localities. Education was correlated with better MHM, women with nine or more years of education had greater odds (AOR = 5.88, CI 5.56–6.22 in rural and AOR = 6.61, CI 6.18–7.08 in urban) of using improved methods than women with less education (AOR = 1.86, CI 1.74–1.99 in rural and AOR = 1.88, CI 1.73–2.04 in urban). In both localities women with a religion of 'other' had greater odds of using improved methods (AOR = 2.7, CI 2.61–2.82 in rural and AOR = 2.1, CI 2.09–2.29 in urban) than Hindu and Muslim women. None of the caste categories had a protective effect related to the usage of improved methods in both settings. Increasing wealth index was also correlated with improved methods. Women from the richest strata were in both localities more likely to use improved methods (AOR = 3.92, CI 3.69–4.16 in rural and AOR = 4.95, CI 4.07–6.03 in urban) than women from lower strata. In both areas, women with access to improved toilet facilities were at higher odds of having good MHM (AOR = 1.62, CI 1.56–1.68 in rural and AOR = 1.89, CI 1.79–2.00 in urban). Interestingly, women reporting having heard a hygiene message from friends were less likely to use improved methods than their category counterparts in both localities. However, women in both areas who have heard/seen a message about personal hygiene (TV, newspapers, teachers, doctors, relatives, others) were more likely to use improved methods.

Self-reported symptoms of RTIs and their relation to menstrual hygiene management by localities. Results of the logistic regression model for self-reported symptoms of RTIs are displayed in Table 3. Women using improved methods were less likely to suffer from RTIs across localities, although using improved methods had no effect on reported symptoms of urinary infections for women in rural areas: UTIs (AOR = 0.99, CI 0.95–1.03 in rural and AOR= 0.84, CI 0.80–0.88 in urban), vaginal discharge (AOR = 0.82, CI 0.78–0.86 in rural and AOR = 0.77, CI 0.70–0.78 in urban). For all women of younger age being aware of RTI/STI, being currently married and with higher number of pregnancies was associated with RTIs. However, women with higher education level and wealth index were less likely to suffer from RTIs than their categories counterparts in both areas. Also, women who married at younger ages had lower odds of suffering RTIs. There were also differences across localities, for example: women having heard/seen a message about personal hygiene had higher odds of suffering RTIs in both areas; however in urban areas the result was not significant regarding vaginal discharge. Improved toilets had a significant association with fewer RTIs in rural areas, but not in urban. Belonging to

Copyright

Table 2 Improved method use by background characteristics of ever-married women in India, stratified by localities (rural/urban), 2007–08, DLHS-3

Background characteristics	*Rural*		*Urban*	
	AOR (95% CI)	*p value*	*AOR (95% CI)*	*p value*
Biological				
Age	0.978 (0.976–0.981)	**0.001**	0.993 (0.991–0.996)	**0.001**
Personal				
Years of education				
Non-literate (Ref)				
1–5	1.865 (1.747–1.992)	**0.001**	1.886 (1.736–2.048)	**0.001**
6–8	2.979 (2.804–3.165)	**0.001**	2.850 (2.648–3.068)	**0.001**
9 and above	5.884 (5.558–6.229)	**0.001**	6.617 (6.180–7.085)	**0.001**
Heard/seen message about personal hygiene				
No (Ref)				
Yes	1.465 (1.378–1.557)	**0.001**	1.637 (1.517– 1.766)	**0.001**
Interpersonal				
Awareness of RTI/STI				
No (Ref)				
Yes	1.359 (1.316–1.403)	**0.001**	1.318 (1.279–1.359)	**0.001**
Hygiene message from friends				
No (Ref)				
Yes	0.821 (0.794–0.848)	**0.001**	0.859 (0.833–0.885)	**0.001**
Environmental				
Toilet facility				
Unimproved (Ref)				
Improved	1.620 (1.560–1.681)	**0.001**	1.898 (1.797–2.004)	**0.001**
Societal				
Religion				
Hindu (Ref)				
Muslims	1.816 (1.725–1.911)	**0.001**	1.177 (1.125–1.231)	**0.001**
Others	2.719 (2.616–2.825)	**0.001**	2.189 (2.091–2.292)	**0.001**
Caste				
SC/ST (Ref)				
Other castes	0.652 (0.627–0.679)	**0.001**	0.871 (0.835–0.909)	**0.001**
No caste	0.655 (0.628–0.683)	**0.001**	0.640 (0.613–0.669)	**0.001**

Copyright

Background characteristics	*Rural*		*Urban*	
	AOR (95% CI)	*p value*	*AOR (95% CI)*	*p value*
Wealth index				
Poorest/poor (Ref)				
Middle	1.746 (1.637–1.861)	**0.001**	1.735 (1.402–2.146)	**0.001**
Richer/richest	3.923 (3.696–4.164)	**0.001**	4.958 (4.070–6.038)	**0.001**
Others				
Age at marriage	1.072 (1.067–1.077)	**0.001**	1.079 (1.074–1.084)	**0.001**
Marital status				
Not currently married (Ref)				
Currently married	0.913 (0.840–0.991)	**0.030**	1.059 (0.981–1.143)	0.142
Reproductive information				
Total pregnancies				
No pregnancy (Ref)				
1–3	0.836 (0.798–0.876)	**0.001**	0.904 (0.859–0.951)	**0.001**
4 and above	0.730 (0.681–0.782)	**0.001**	0.579 (0.539–0.622)	**0.001**
Induced abortion				
No abortion (Ref)				
1–3	0.897 (0.817–0.985)	**0.023**	1.077 (1.006–1.154)	**0.034**
4 and above	0.805 (0.532–1.281)	0.304	1.175 (0.885–1.559)	0.264
Spontaneous abortion				
No abortion (Ref)				
1–2	1.010 (0.954–1.017)	0.731	1.128 (1.072–1.186)	**0.001**
3 and above	0.949 (0.755–1.192)	0.651	1.001 (0.832–1.204)	0.992

Note*:* Ref is reference category; significant *p* values shown in bold

'others' religion category had decreased odds for vaginal discharge and UTIs in rural settings. Yet, in urban settings belonging to 'others' religion category had increased odds for UTIs, but the result was not significant for vaginal discharge (AOR = 0.98, CI 0.91–1.05). In both localities women who belong to the 'no caste' category were less likely to have UTIs (AOR = 0.93, CI 0.91–0.95 in rural and AOR = 0.86, CI 0.82–0.89 in urban).

Discussion

This study investigates whether socio-demographic differences in rural and urban India affect women's MHM practices, and how the factors involved in MHM were associated with RTIs. The results showed that more women have access to proper MHM in urban than in rural areas, yet a deeper look at the factors that impact MHM indicate that women from both areas share many of the socio-demographic factors and that poor

Copyright

Table 3 Self-reported symptoms of RTIs (vaginal discharge and UTIs) by background characteristics of ever-married women in India, stratified by localities (rural/urban), 2007–08, DLHS-3

Background characteristics	*Rural*				*Urban*			
	UTIs		*Vaginal discharge*		*UTIs*		*Vaginal discharge*	
	AOR (95% CI)	*P value*	*AOR (95% CI)*	*P value*	*AOR (95% CI)*	*P value*	*AOR (95% CI)*	*P value*
Biological								
Age	1.002 (1.001–1.003)	**0.003**	0.987 (0.986–0.989)	**0.001**	0.993 (0.991–0.996)	**0.001**	0.973 (0.970–0.977)	**0.001**
Personal								
Years of education								
Non-literate (Ref)								
1–5	1.068 (1.045–1.092)	**0.001**	0.917 (0.948–0.995)	**0.018**	1.015 (0.963–1.070)	0.578	0.862 (0.815–0.913)	**0.001**
6–8	1.056 (1.030–1.083)	**0.001**	0.926 (0.900–0.952)	**0.001**	0.915 (0.868–0.964)	**0.001**	0.796 (0.752–0.842)	**0.001**
9 and above	0.890 (0.866–0.914)	**0.001**	0.745 (0.723–0.769)	**0.001**	0.756 (0.717–0.796)	**0.001**	0.631 (0.596–0.668)	**0.001**
Heard/seen a message about personal hygiene								
No (Ref)								
Yes	1.167 (1.139–1.196)	**0.001**	1.124 (1.094–1.155)	**0.001**	1.182 (1.106–1.263)	**0.001**	1.068 (0.993–1.148)	0.076
Interpersonal								
Awareness of RTI/STI								
No (Ref)								
Yes	1.213 (1.193–1.234)	**0.001**	1.288 (1.264–1.313)	**0.001**	1.227 (1.186–1.269)	**0.001**	1.211 (1.166–1.258)	**0.001**

Copyright

Copyright

Background characteristics	*Rural*				*Urban*			
	UTIs		*Vaginal discharge*		*UTIs*		*Vaginal discharge*	
	AOR (95% CI)	*P value*	*AOR (95% CI)*	*P value*	*AOR (95% CI)*	*P value*	*AOR (95% CI)*	*P value*
Hygiene message from friends								
No (Ref)								
Yes	0.981 (0.963–0.999)	0.043	1.106 (1.084–1.130)	**0.001**	1.015 (0.979–1.105)	0.421	1.148 (1.103–1.195)	**0.001**
Environmental								
Toilet facilities								
Unimproved (Ref)								
Improved	0.973 (0.952–0.995)	**0.014**	0.985 (0.935–0.982)	**0.001**	1.012 (0.966–1.060)	0.624	0.997 (0.948–1.049)	0.910
Absorbents used								
Unhygienic (Ref)								
Hygienic	0.994 (0.954–1.036)	0.776	0.823 (0.781–0.867)	**0.001**	0.843 (0.806–0.881)	**0.001**	0.774 (0.705–0.784)	**0.001**
Societal								
Religion								
Hindu (Ref)								
Muslims	1.587 (1.550–1.626)	**0.001**	1.620 (1.579–1.662)	**0.001**	1.427 (1.368–1.489)	**0.001**	1.469 (1.404–1.537)	**0.001**
Others	0.908 (0.884–0.933)	**0.001**	0.638 (0.615–0.661)	**0.001**	1.304 (1.233–1.489)	**0.001**	0.982 (0.915–1.053)	0.609
Caste								
SC/ST (Ref)								
Other castes	1.501 (1.104–1.153)	**0.001**	1.271 (1.240–1.302)	**0.001**	0.993 (0.948–1.039)	0.750	1.173 (1.113–1.236)	**0.001**
No caste	0.933 (0.916–0.951)	**0.001**	1.131 (1.108–1.155)	**0.001**	0.858 (0.821–0.896)	**0.001**	1.037 (0.987–1.089)	0.152

(Continued)

Copyright

Table 3 Continued

Background characteristics	*Rural*				*Urban*			
	UTIs		*Vaginal discharge*		*UTIs*		*Vaginal discharge*	
	AOR (95% CI)	*P value*	*AOR (95% CI)*	*P value*	*AOR (95% CI)*	*P value*	*AOR (95% CI)*	*P value*
Wealth index								
Poorest/poor (Ref)								
Middle	1.025 (1.005–1.046)	**0.016**	1.023 (1.001–1.045)	**0.045**	0.918 (0.852–0.989)	**0.025**	0.917 (0.847–0.992)	**0.031**
Richer/richest	0.892 (0.872–0.913)	**0.001**	0.993 (0.909–0.957)	**0.001**	0.820 (0.764–0.882)	**0.001**	0.861 (0.798–0.929)	**0.001**
Others								
Age at marriage	0.987 (0.985–0.990)	**0.001**	0.961 (0.959–0.964)	**0.001**	0.982 (0.997–0.998)	**0.001**	0.975 (0.970–0.981)	**0.001**
Marital status								
Not currently married (Ref)								
Currently married	1.320 (1.268–1.375)	**0.001**	1.163 (1.113–1.216)	**0.001**	1.264 (1.168–1.368)	**0.001**	1.097 (1.006–1.195)	**0.036**
Reproductive information								
Total pregnancies								
No pregnancy (Ref)								
1–3	1.332 (1.289–1.377)	**0.001**	1.408 (1.357–1.416)	**0.001**	1.229 (1.146–1.319)	**0.001**	1.496 (1.379–1.623)	**0.001**
4 and above	1.624 (1.563–1.687)	**0.001**	1.863 (1.786–1.944)	**0.001**	1.555 (1.431–1.690)	**0.001**	2.258 (2.054–2.483)	**0.001**
Induced abortion								
No abortion (Ref)								
1–2	1.548 (1.480–1.618)	**0.001**	1. 435 (1.367–1.507)	**0.001**	1.502 (1.402–1.610)	**0.001**	1.450 (1.344–1.565)	**0.001**
3 and above	2.260 (1.945–2.626)	**0.001**	1.696 (1.433–2.008)	**0.001**	1.943 (1.538–2.454)	**0.001**	1.371 (1.044–1.799)	**0.023**

Copyright

Background characteristics	*Rural*				*Urban*			
	UTIs		*Vaginal discharge*		*UTIs*		*Vaginal discharge*	
	AOR (95% CI)	*P value*	*AOR (95% CI)*	*P value*	*AOR (95% CI)*	*P value*	*AOR (95% CI)*	*P value*
Spontaneous abortion								
No abortion (Ref)								
1–2	1.356 (1.322–1.390)	**0.001**	1.439 (1.401–1.478)	**0.001**	1.352 (1.287–1.421)	**0.001**	1.419 (1.345–1.496)	**0.001**
3 and above	1.484 (1.371–1.606)	**0.001**	1.580 (1.455–1.717)	**0.001**	1.606 (1.389–1.856)	**0.001**	1.523 (1.304–1.779)	**0.001**
IUD								
Other (Ref)								
Yes	1.060 (0.994–1.131)	0.075	1.110 (1.031–1.194)	**0.001**	0.997 (0.903–1.100)	0.947	1.078 (0.967–1.201)	0.176
Currently pregnant								
No (Ref)								
Yes	0.917 (0.890–0.945)	**0.001**	0.759 (0.733–0.786)	**0.001**	0.917 (0.905–1.041)	0.402	0.818 (0.755–0.886)	**0.001**
Breastfeeding								
No (Ref)								
Yes	0.865 (0.848–0.883)	**0.001**	0.838 (0.820–0.857)	**0.001**	0.906 (0.864–0.950)	**0.001**	0.866 (0.823–0.912)	**0.001**

Note: Ref is reference category; significant *p* values shown in bold

MHM is a problem all across India. In both localities the usage of unimproved methods, especially cloths, is very common. These findings are consistent with other studies, which indicates that women from both areas prefer cloths (Deo and Ghattargi, 2005). The same results were found for women from LMICs such as Tanzania, Ghana, and Cambodia (Sommer et al., 2014). Cloth sanitary products can be hygienic if selected, washed, and dried appropriately; they are also friendlier to the environment and cheaper, and therefore more accessible (Hennegan and Montgomery, 2016). Sadly, in LMICs cleaning and drying cloths properly is difficult due to lack of water and proper facilities, but also due to taboos and misconceptions that cause shame in girls and women. Due to the stigma associated with menstruation, washed menstrual cloths are often dried in secluded places or under other clothes which could compromise hygiene (Anand et al., 2015; van Eijk et al., 2016).

Factors associated with appropriate MHM are very similar to those found in other studies. Higher socio-economic and educational status were protective factors for good MHM as established in the literature (Anand et al., 2015). In India, religion plays an important role. Women who follow Hinduism and Islam were more likely to use unimproved methods in both localities, reiterating findings from a previous study (Garg Suneela, 2015). This is possibly because Hinduism and Islam, the two main religions in India followed by 75 per cent and 11.4 per cent of the population respectively (IIPS, 2010), consider menstruation 'impure' and impose severe restrictions upon menstruation practices such as prohibiting access to water so that women can clean themselves (Guterman et al., 2007). Some aspects of misconceptions such as secluded places for menstruating women and girls in the house seem to be less prevalent, especially in urban areas. However, restriction on visiting places of worship, touching religious items, and praying seem to be common across settings in India (van Eijk et al., 2016). Improved toilet facilities enabled women and girls to have better MHM and fewer RTIs (Paria et al., 2014; Das et al., 2015). Other studies have found similar results, highlighting the importance of ensuring access to improved toilet facilities throughout India, where around 50 per cent of the population in the cities do not have proper sanitation facilities, including schools (Burra et al., 2003; Muralidharan et al., 2015). Awareness of sexually transmitted diseases and personal hygiene variables were related to greater odds of hygienic product usage in both areas, echoing a study conducted in 2015 in India (Anand et al., 2015). In contrast, the lower odds of using improved methods associated with hearing messages about hygiene from friends may be related to misinformation from peers.

A trend was found between the usage of different absorbents and RTIs. Women using improved methods were less likely to develop genitourinary infections, which is consistent with findings from another study (Das et al., 2015). Although the usage of improved methods did not have an effect on UTIs in rural settings, it was associated with decreased risk of UTIs in urban settings. The results may be attributable to recall bias from the participants, as in the study we used self-reported symptoms for RTIs in the last three months. Not surprisingly, we found that the main factors impacting RTIs were, as with MHM, almost identical between rural and urban areas. Previous studies often reported significant differences between these two areas; however, these were conducted with a smaller

Copyright

population (Thakre et al., 2012; Paria et al., 2014; Anand et al., 2015). Another explanation might be that other studies were looking into the specific effects of newly implemented programmes, rather than trying to understand the main differences between urban and rural areas regarding RTIs and association with MHM. Furthermore, most studies on the subject used residence (rural/urban) as one of the independent variables, and for this reason urban women are usually found to have better MHM than rural women (Anand et al., 2015). Nevertheless, this study points out that in India, MHM and RTIs are a major concern for all women regardless of the place of residence as they share most of the determining factors.

Strengths and limitations

Although we found that using unimproved methods is associated with RTIs (vaginal discharge/UTIs) in both localities, we did not have information on many other factors related to the development of RTIs such as: access to clean water and procedures followed to clean genitals, and concrete information about sexuality. Also, if the respondents reported to be using improved methods, it was not known if they make proper use of them. This is important in classifying improved MHM as guidelines recommend changing the absorbents every 2 to 6 hours (Hennegan and Montgomery, 2016). On the other hand, for women who reported using unimproved methods, we did not know how they clean and dry the materials used, which is also important for a proper classification. All this information could have given a better and more accurate understanding about the relation between the socio-demographic factors and their influence on MHM as well as the association between MHM and RTIs. However, using reported symptoms still has value as it contributes to a better understanding of the risk factors in poor settings where people have difficulties accessing health centres with all the infrastructure needed, such as a laboratory to run the test (Baker et al., 2017; Das et al., 2018). Despite the limitations, this study is the first to provide representative information about the main socio-demographic factors influencing MHM and its relationship with RTIs, stratifying the population into rural and urban areas in India. The data was drawn from women aged 15 to 49 years old, which is a unique characteristic of our study, as most studies on this particular issue focus only on girls and/or adolescents, leaving older women unstudied. Lastly, the population size was large enough for robust statistical analysis.

Study implications

Unmet MHM needs for women and girls in India can lead to RTIs and other morbidities. The policies and programmes around MHM are weak in India. Subsequently there is an urgent need for all health agencies to address MHM in a more comprehensive way, at all levels: from the biological (menstrual cycle and intensity); personal (knowledge, skills for coping, and behavioural adaptations); interpersonal (relation with family, teachers, peers); and environmental (access to WASH, disposal of soil waste, maintenance of facilities, availability and affordability of sanitary protection materials) to societal (policies, strategies, traditional, and cultural norms)

Copyright

(Dutta et al., 2016). In 2015 the government of India together with UNICEF released the *Menstrual Hygiene Management: National Guidelines* as a step forward to improve women and girls' hygiene practices during menstruation (Kaiser, 2015).

Acknowledgement

The authors would like to thank Joel Monárrez, Usman, Amphi 11, Mieke, and Rachel for all their help and support. Thanks also to the first author's family, especially Poyo.

References

Anand, E., Singh, J. and Unisa, S. (2015) 'Menstrual hygiene practices and its association with reproductive tract infections and abnormal vaginal discharge among women in India', *Sexual and Reproductive Healthcare* 6(4): 249–54 <http://dx.doi.org/10.1016/j.srhc.2015.06.001>.

Aniebue, U.U., Aniebue, P.N. and Nwankwo, T.O. (2009) 'The impact of pre-menarcheal training on menstrual practices and hygiene of Nigerian school girls', *The Pan African Medical Journal* 2: 9 <http://dx.doi.org/10.4314/pamj.v2i1.51708>.

Auemaneekul, N., Bhandari, S. and Kerdmongkol, P. (2013) 'Menstrual hygiene practice among adolescent in a rural district of Nepal', *Asia Journal of Public Health* 4: 8–15.

Baker, K.K., Padhi, B., Torondel, B., Das, P., Dutta, A., Sahoo, K.C., Das, B., Dreibelbis, R., Caruso, B., Freeman, M.C., Sager, L. and Panigrahi, P. (2017) 'From menarche to menopause: a population-based assessment of water, sanitation, and hygiene risk factors for reproductive tract infection symptoms over life stages in rural girls and women in India', *PLoS ONE* 12(12): 1–20 <http://dx.doi.org/10.1371/journal.pone.0188234>.

Burra, S., Patel, S. and Kerr, T. (2003) 'Community-designed, built and managed toilet blocks in Indian cities', *Environment and Urbanization* 15(2): 11–32 <https://journals.sagepub.com/doi/10.1177/095624780301500202>.

Central Intelligence Agency (CIA) (no date) 'World Factbook: South Asia: India' [online] <https://www.cia.gov/library/publications/the-world-factbook/geos/in.html> [accessed 20 February 2019].

Das, P., Baker, K.K., Dutta, A., Swain, T., Sahoo, S., Das, B.S., Panda, B., Nayak, A., Bara, M., Bilung, B., Mishra, P.R., Panigrahi, P., Cairncross, S. and Torondel, B. (2015) 'Menstrual hygiene practices, WASH access and the risk of urogenital infection in women from Odisha, India', *PLoS ONE* 10(6): e0130777 <http://dx.doi.org/10.1371/journal.pone.0130777>.

Das, P., Swain, T., Mohanty, J.R., Sinha, S., Padhi, B., Torondel, B., Cumming, O., Panda, B., Nayak, A. and Panigrahi, P. (2018) 'Higher vaginal pH in Trichomonas vaginalis infection with intermediate Nugent score in reproductive-age women: a hospital-based cross-sectional study in Odisha, India', *Parasitology Research* 117(9): 2735–42 <http://dx.doi.org/10.1007/s00436-018-5962-z>.

Deo, D. and Ghattargi, C. (2005) 'Perceptions and practices regarding menstruation: a comparative study in urban and rural adolescent girls', *Indian Journal of Community Medicine* 30(1): 33–4.

Dielubanza, E.J. and Schaeffer, A.J. (2011) 'Urinary tract infections in women', *Medical Clinics of North America* 95(1): 27–41 <http://dx.doi.org/10.1016/j.mcna.2010.08.023>.

Dutta, D., Badloe, C., Lee, H. and House, S. (2016) *Supporting the Rights of Girls and Women through Menstrual Hygiene Management (MHM) in the East Asia and Pacific Region: Realities, Progress and Opportunities* [pdf] <http://menstrualhygieneday.org/supporting-rights-girls-women-menstrual-hygiene-management-mhm-east-asia-pacific-region/> [accessed 20 February 2019].

Copyright

van Eijk, A.M., Sivakami, M., Thakkar, M.B., Bauman, A., Laerson, K.F., Coates, S. and Phillips-Howard, P.A. (2016) 'Menstrual hygiene management among adolescent girls in India: a systematic review and meta-analysis', *BMJ Open* 6(3): e010290 <http://dx.doi.org/10.1136/bmjopen-2015-010290>.

Garg, R., Goyal, S. and Gupta, S. (2012) 'India moves towards menstrual hygiene: subsidized sanitary napkins for rural adolescent girls – issues and challenges', *Maternal and Child Health Journal* 16(4): 767–74 <http://dx.doi.org/10.1007/s10995-011-0798-5>.

Garg Suneela, A.T. (2015) 'Menstruation related myths in India: strategies for combating it', *Journal of Family Medicine and Primary Care* 4(2): 184–6 <http://dx.doi.org/10.4103/2249-4863.154627>.

Guterman, M., Mehta, P. and Gibbs, M. (2007) 'Menstrual taboos among major religions', *The Internet Journal of World Health and Societal Politics* 5(2): 1–7.

Guyton, A.C. and Hall, J.E. (2006) 'Female physiology before pregnancy and female hormones', in R. Gruliow and L. Belfus (eds), *Medical Physiology*, 11th edn, pp. 1011–26, London: Elsevier.

Hennegan, J. and Montgomery, P. (2016) 'Do menstrual hygiene management interventions improve education and psychosocial outcomes for women and girls in low and middle income countries?' *PLoS ONE* 11(2): e0146985 <http://dx.doi.org/10.1371/journal.pone.0146985>.

House, S., Mahon, T. and Cavill, S. (2013) 'Bookshelf: Menstrual Hygiene Matters: a resource for improving menstrual hygiene around the world, 2012 www.wateraid.org/mhm', *Reproductive Health Matters* 21(41): 257–59 <http://dx.doi.org/10.1016/S0968-8080(13)41712-3>.

International Institute for Population Sciences (IIPS) (2010) *District Level Household and Facility Survey (DLHS-3), 2007-08: India*, Mumbai: IIPS.

Kaiser, S. (2015) *Menstrual Hygiene Management: National Guidelines* [online], Ministry of Drinking Water and Sanitation, Government of India <https://mdws.gov.in/menstrual-hygiene-management-national-guidelines-december-2015> [accessed 20 February 2019].

Khanna, A. and Bhawsar, R. (2005) 'Menstrual practices and reproductive problems: a study of adolescent girls in Rajasthan', *Journal of Health Management* 7(1): 91–107 <http://dx.doi.org/10.1177/097206340400700103>.

Long, J., Caruso, B.A., Diego, L., Vancraeynest, K., Sahin, M., Andes, K.L. and Freeman, M.C. (2013) *WASH in Schools Empowers Girls' Education in Rural Cochabamba, Bolivia: An assessment of menstrual hygiene management in schools*, New York: United Nations Children's Fund.

Mahon, T. and Fernandes, M. (2010) 'Menstrual hygiene in South Asia: a neglected issue for WASH (water, sanitation and hygiene) programmes', *Gender & Development* 18(1): 99–113 <http://dx.doi.org/10.1080/13552071003600083>.

McCathie, R. (2006) 'Vaginal discharge: common causes and management', *Current Obstetrics and Gynaecology* 16(4): 211–7 <http://dx.doi.org/10.1016/j.curobgyn.2006.05.004>.

McMahon, S., Winch, P.J., Caruso, B., Obure, A.F., Ogutu, E.A., Ochari, I.A. and Rheingans, R.D. (2011) '"The girl with her period is the one to hang her head" reflections on menstrual management among schoolgirls in rural Kenya', *BMC International Health and Human Rights* 11(1): 7 <http://dx.doi.org/10.1186/1472-698X-11-7>.

Muralidharan, A., Patil, H. and Patnaik, S. (2015) 'Unpacking the policy landscape for menstrual hygiene management: Implications for school WASH programmes in India', *Waterlines* 34(1): 79–91 <http://dx.doi.org/10.3362/1756-3488.2015.008>.

Paria, B., Bhattacharyya, A. and Das, S. (2014) 'A comparative study on menstrual hygiene among urban and rural adolescent girls of West Bengal', *Journal of Family Medicine and Primary Care* 3(4): 413–7 <http://dx.doi.org/10.4103/2249-4863.148131>.

Copyright

Phillips-Howard, P.A., Caruso, B., Torondel, B., Zulaika, G., Sahin, M. and Sommer, M. (2016) 'Menstrual hygiene management among adolescent schoolgirls in low and middle-income countries: research priorities', *Global Health Action* 1: 1–7 <http://dx.doi.org/10.3402/gha.v9.33032>.

Rabiu, K.A., Adewunmi, A.A., Akinlusi, F.M. and Akinola, O.L. (2010) 'Female reproductive tract infections: understandings and care seeking behaviour among women of reproductive age in Lagos, Nigeria', *BMC Women's Health* 10: 2–8 <http://dx.doi.org/10.1186/1472-6874-10-8>.

Salvatore, S., Cattoni, E., Siesto, G., Serati, M., Sorice, P. and Torella, M. (2011) 'Urinary tract infections in women', *European Journal of Obstetrics & Gynecology and Reproductive Biology* 156(2): 131–6 <http://dx.doi.org/10.1016/j.ejogrb.2011.01.028>.

Sommer, M., Ackatia-Armah, N., Connolly, S. and Smiles, D. (2014) 'A comparison of the menstruation and education experiences of girls in Tanzania, Ghana, Cambodia and Ethiopia', *Compare: A Journal of Comparative and International Education* 45(4): 589–609 <http://dx.doi.org/10.1080/03057925.2013.871399>.

Sommer, M., Hirsch, J.S., Nathanson, C. and Praker, R.G. (2015) 'Comfortably, safely, and without shame: defining menstrual hygiene management as a public health issue', *American Journal of Public Health* 105(7): 1302–11 <http://dx.doi.org/10.2105/AJPH.2014.302525>.

Sommer, M., Chandraratna, S., Cavill, S., Mahon, T. and Phillips-Howard, P. (2016) 'Managing menstruation in the workplace: an overlooked issue in low- and middle-income countries', *International Journal for Equity in Health* 15(1): 86 <http://dx.doi.org/10.1186/s12939-016-0379-8>.

Sumpter, C. and Torondel, B. (2013) 'A systematic review of the health and social effects of menstrual hygiene management', *PLoS ONE* 8(4): e62004 <http://dx.doi.org/10.1371/journal.pone.0062004>.

Thakre, S.B., Thakre, S.S., Ughade, S. and Thakre, A.D. (2012) 'Urban-rural differences in menstrual problems and practices of girl students in Nagpur, India', *Indian Pediatrics* 49(9): 733–6 <http://dx.doi.org/10.1007/s13312-012-0156-8>.

UNICEF (2015) '*MHM in Ten': Advancing the MHM Agenda in WASH in Schools* [pdf] <https://www.unicef.org/wash/schools/files/MHM_in_Ten_2015.pdf> [accessed 20 February 2019].

World Bank (no date) 'Data: India' [online] <http://data.worldbank.org/country/india> [accessed 20 February 2019].

Copyright