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Menstrual management in low-income countries: needs and trends

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Access to appropriate facilities for menstrual hygiene and management (MHM) is recognized as a neglected need within the sanitation sector globally. However, little is known about the magnitude or trajectory of this need. Further, the particular services and facilities required to meet MHM needs depend on the practices and products employed by women and girls. We use nationally representative data from 58 low and lower-middle income countries to estimate that 800 million women in such countries menstruate regularly. Positive correlations between menstruation and nutritional status, as well as menstruation and household wealth, imply a growing need for menstrual management solutions as poverty declines, but both effects are dwarfed by the impact of declining fertility rates. Data on imports of disposable menstrual products reveal exponential growth in their use in low and especially lower-middle income countries. This trend is likely to continue as incomes grow and markets develop, making ever greater the need for provision of appropriate disposal facilities.

Keywords: menstrual management, sanitation systems, hygiene, sanitary product disposal

As evidenced by recent publications and themes in international conferences and workshops, there is growing recognition in the sanitation research and policy communities that women's particular sanitation needs are a central and often neglected dimension within the goal of providing universal sanitation. The lack of appropriate facilities for managing menstrual hygiene is an important way in which many sanitation systems fall short of meeting the needs of women and girls. Previous work has shown that many women and girls in low-income (LI) and lower-middle income (LMI) countries struggle to find appropriate space to deal with menses, which may impact their work and school participation, and could contribute to hygiene-related health problems (Sommer, 2011; Crofts and Fisher, 2012). Further, mounting evidence shows that inappropriately disposed menstrual management materials can lead to sanitation system blockages and other system failures (Bharadwaj and Patkar, 2004; Kjellen et al., 2011; Sommer, 2011). Ensuring

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appropriate facilities for washing and disposal of these materials should therefore be integrated into system planning as sanitation coverage is extended throughout the developing world.

The first objective of this article is to shed light on the current magnitude and likely trajectory of the need for menstrual hygiene solutions in LI and LMI countries, where sanitation coverage is expanding most rapidly and where facilities for appropriate disposal of menstrual waste are most likely to be lacking. Given that the population rate of menstruation is affected by fertility and breastfeeding rates, as well as by population nutritional and health status (Harlow and Campbell, 2000, 2004), all of which vary widely across countries, the number of women who menstruate regularly in low and lower-middle income parts of the world is unknown. By quantifying the size of this need, globally and for subpopulations by age, region, urban versus rural residence, and type of sanitation facility used, we aim to provide policy makers with a basis for prioritizing investment in sanitation systems in order to both allow women to manage their menses with dignity, and avoid negative impacts on sanitation system function. By analysing the association between menstruation, nutritional status, and socio-economic status, we attempt to shed light on how the need for menstrual management solutions is likely to evolve over time.

Second, we provide data on the time trend of disposable menstrual product use in LI and LMI countries. The degree to which menstrual product waste poses a problem to sanitation systems differs across sanitation systems, as does the definition of a sanitation system-friendly menstrual product (Kjellen et al., 2011). Thus, understanding how the use of such products is changing over time can help inform policy makers of the type of facilities and systems required for the cleaning or appropriate disposal of menstrual products.

We use the World Bank definition of low-income and lower-middle income countries. LI is defined as 2010 income per capita of US$1,005 or less and LMI is defined as 2010 income per capita in the range of $1,006–3,975. LI and LMI countries are often referred to by the more general terms ‘developing countries’ or ‘developing regions’, and we maintain this language when citing other works.

Evidence on the rate of menstruation in LI and LMI countries

No studies of which we are aware document the rate of menstruation in LI and LMI countries, but several studies point to the possibility that the rate differs from that in higher income countries. Fertility may be the most important driver of variation in the rate of menstruation globally. The mean fertility rate for low-income countries in 2010 was 4.08, lower-middle income 2.93, and high-income countries was 1.76 (World Bank data, 2012). Epidemiological studies also suggest that malnutrition and obesity as well as other health problems such as endometrial tuberculosis and AIDS wasting (Harlow and Campbell, 2000, 2004) are associated with lower levels of menstruation. WHO statistics estimate that anaemia affects three to four times more individuals in developing regions relative to developed (Allen and

Casterline-Sabel, 2001). A recent review of studies on menstrual abnormalities in low-income countries found that reported rates of irregular bleeding ranged from 8 to 83 per cent, and that estimates of amenorrhoea ranged from 5 to 13 per cent (Harlow and Campbell, 2004).

Evidence on current menstrual practices

The limited data that exist suggest that most poor women in low and lower-middle income countries use old cloths to absorb menstrual blood (Seymour 2008; Scott et al., 2009; Sommer, 2010; Crofts and Fisher, 2012). Only a small fraction of menstruating women in LI and LMI countries currently use sanitary napkins or other marketed menstrual-management products. For example, in India it is estimated that only 10–11 per cent of menstruating women use disposable napkins (Garg et al., 2012) and in Uganda the average cost of one packet of napkins, which is estimated to be higher than the daily income of a working parent, prevents many women and girls from using these disposable products (Crofts and Fisher, 2012). Cost, awareness, and availability are cited as primary barriers to use of sanitary napkins (Scott et al., 2009; Garg et al., 2012; Crofts and Fisher, 2012). In contrast, in the United States and higher income European countries, where the cost of pads is well below the minimum hourly wage and access to pads is universal, 73–92 per cent of menstruating women use disposable menstrual management products (Garg et al., 2012).

The increasing focus by the private sector on marketing menstrual hygiene products in so-called emerging markets (see for example Proctor & Gamble, 2010), suggests that use of marketed products is expanding. Government policies and plans for provision of subsidized disposable napkins, for example in South Africa and India, may also lead to increased availability and reduced prices of menstrual products (SWETA, 2010; Northern Cape Provincial Government, 2010; *The Tribune,* 2011). Alternatives such as reusable or biodegradable pads (e.g. Afripad and Makapads, see Crofts and Fisher, 2012) and menstrual cups (e.g. Ruby Cup, Shecup, Mpower Menstrual Cup, see Oster and Thornton, 2009) are also becoming increasingly available, but on a very small scale.

Methods

Data sources

We use data from various demographic and health surveys (DHS) to estimate the proportion and total number of women menstruating across LI and LMI countries. The DHS is a nationally representative household survey that has been conducted in 58 of the 96 LI and LMI countries. The survey covers topics including demographic characteristics, women's menstruation history and pregnancy status, and type of sanitation systems used by respondents. World Bank 2008 population estimates are then used to generate country and regional population weights, so that countries

with larger populations are given more weight in the estimated regional averages, and more populous regions are given more importance in the global estimates.

The second part of the analysis uses data from Global Trade Information Systems (GTIS), a private firm that consolidates international merchandise trade data reported by governments for a wide range of product categories including menstrual management products.

Current magnitude of the need for MHM solutions

In DHS surveys, two standard questions about menstruation are asked of one randomly selected woman between the ages of 15 and 45 in each participating household. First, the respondent is asked whether she menstruated within the past six weeks, then, the time since last menstrual period. Because responses to the second question are often missing, we use the six-week recall question to construct estimates of the number of regularly menstruating women.

A limitation of our study is that our data exclude girls under the age of 15. A study by Thomas et al. (2001) has shown the mean age at menarche across 67 countries to be as low as 12 years. As such, all presented estimates of number of menstruating women may be viewed as a lower bound.

As DHS data are not available for all countries, the countries for which these data exist are assumed to be representative of their region (Table 1). This is a strong assumption in those regions where a relatively low proportion of the LI and LMI population is represented, particularly in East Asia, and represents a limitation of our study. However, in most regions, particularly the populous regions of South Asia, sub-Saharan Africa, and Latin American and the Caribbean, over 70 per cent of countries, and between 50 and 99 per cent of the LI and LMI population is represented, except for East Asia where only 26 per cent is represented (Table A.1). Globally, the data used in this analysis are representative of 60 per cent of LI and LMI countries, and 64 per cent of the global LI and LMI population.

Specifically, regional statistics are calculated by multiplying country-level menstruation rates by the proportion of the total DHS-represented population contributed by the particular country, using population data from 2008 estimates by the World Bank. In turn, global estimates are calculated using regional estimates weighted by regional population as a proportion of global population.

Sub-population analysis

In order to shed light on the need for menstruation-appropriate facilities to be incorporated into specific sanitation types, the exercise above is repeated for sub-populations defined by the primary sanitation system used, according to DHS data. Sanitation data are available for most countries in the DHS data set (Table 1). We categorize sanitation systems broadly as flush toilet, pit latrine, and no facility. The consequences of inappropriate disposal of menstrual waste through each of these types of sanitation system are distinct, with disposal into flush systems likely to result in clogs, and disposal into pit latrines shortening the useful life of the

Table 1 Demographic and health survey data used in sample

Country	*Income category*[1]	*Survey data year*	*Sanitation data available (Y/N)*
Sub-Saharan Africa			
Burkina Faso	LI	2003	Y
Burundi	LI	1987	Y
Cameroon	LMI	2004	Y
Congo, Dem. Rep.	LI	2007	Y
Congo, Brazzaville	LMI	2005	Y
Cote d'Ivoire	LMI	1999	Y
Ethiopia	LI	1997	Y
Ghana	LI	2008	Y
Guinea	LI	1999	Y
Kenya	LI	2008	Y
Lesotho	LMI	2009	Y
Liberia	LI	2009	Y
Madagascar	LI	2009	N
Malawi	LI	2004	Y
Mali	LI	2006	Y
Mozambique	LI	2004	Y
Niger	LI	2006	Y
Nigeria	LMI	2008	Y
Rwanda	LI	2005	Y
Sao Tome and Principe	LMI	2008	N
Senegal	LMI	2005	N
Sierra Leone	LI	2008	Y
Sudan	LMI	1989	Y
Swaziland	LMI	2006	Y
Tanzania	LI	1999	Y
Togo	LMI	2008	N
Uganda	LI	2006	N
Zambia	LI	2007	Y
Zimbabwe	LI	2005	N
Middle East and North Africa			
Egypt, Arab Rep.	LMI	2008	Y
Jordan	LMI	2009	Y
Morocco	LMI	2003	Y
Tunisia	LMI	1988	Y
Yemen	LMI	1991	Y
Latin America & Caribbean			
Bolivia	LMI	2008	N
Haiti	LI	2005	Y
Honduras	LMI	2005	Y
Ecuador	LMI	1985	Y
El Salvador	LMI	1987	N
Guatemala	LMI	2005	Y
Nicaragua	LMI	2007	Y
Paraguay	LMI	1990	Y

Country	*Income category*[1]	*Survey data year*	*Sanitation data available (Y/N)*
East Asia			
Cambodia	LI	2006	Y
Indonesia	LMI	2007	Y
Philippines	LMI	2008	Y
Thailand	LMI	1987	Y
Timor-Leste	LMI	2009	Y
Vietnam	LMI	2002	Y
South Asia			
Bangladesh	LI	2007	Y
India	LI	2005	Y
Maldives	LI	2009	Y
Nepal	LI	2006	Y
Pakistan	LMI	2006	Y
Sri Lanka	LMI	1987	Y
Europe and Central Asia			
Armenia	LMI	2005	Y
Kyrgyz Republic	LI	2007	Y
Moldova	LMI	2005	Y
Uzbekistan	LMI	1996	Y

Note: LI = low income, LMI = lower-middle income

pit and creating problems in the emptying of pits in urban settlements (Kjellen et al., 2011). Table A.2 details which specific system types are included in each of these broad categories. Note that our categories differ from those used by the Joint Monitoring Programme of the WHO and UNICEF, which includes both some flush and non-flush systems as 'improved', and some of each as 'unimproved' depending on the destination of sewage and whether or not the facility is shared.

As different government and non-governmental actors often serve rural and urban populations, we disaggregate the need for MHM-appropriate facilities by urban and rural residence. Urban/rural status is a DHS-provided indicator in which urban is defined as living in a city or town with a population of at least 50,000.

The literature reviewed above suggests that usage of disposable menstrual hygiene products is driven largely by income relative to the cost of these products. Further, government programmes aiming to improve the menstrual management options available to women are typically targeted at the poorest. We thus disaggregate menstrual status by wealth level. We calculate wealth quintiles for each country using the household wealth index provided within the DHS data. This wealth index is constructed independently for each country using principal components analysis of durable asset ownership, housing materials, number of rooms in dwelling, and access to electricity, and is a within-country relative measure that cannot be used to make cross-country comparisons. The regional wealth quintiles thus combine, for example, the lowest wealth quintile in low-income Cambodia with the lowest wealth quintile in better-off Thailand.

Projecting the trajectory of MHM needs

As noted above, fertility rates and nutritional status are important drivers of regular menstruation. As these change, the level of demand for menstrual products and need for appropriate sanitation facilities will change as well. DHS data allow us to look at the relationships between fertility and some measures of nutritional status with regular menstruation. With respect to fertility, female DHS respondents are asked whether they are currently pregnant, with possible responses as yes, no, or unsure. In our analysis only women reporting 'no' are treated as not pregnant. To characterize the degree to which fertility affects menstruation patterns in LI and LMI countries, we calculate menstruation both including and excluding pregnant women. This allows us to test whether regional variation in menstruation remains after controlling for differences in fertility.

The DHS data also include measures of nutritional status, including body mass index (BMI), generated from female height and weight data measured by survey staff during data collection, and anaemia status, assessed using blood samples from a subset of female respondents. In this analysis, anaemia status is defined as having haemoglobin concentration under 7.0 g/dL. Our analysis focuses on severe anaemia relative to no–moderate anaemia. The DHS surveys employ WHO haemoglobin cutoff points for detecting mild, moderate, and severe anaemia. Severe anaemia is diagnosed when haemoglobin concentration is less than 7.0 g/dl; moderate anaemia when the haemoglobin concentration is 7.0 to 9.9 g/dl. We conduct a regression analysis estimating the partial impact of BMI and anaemia status on menstrual status, controlling for age, time trends, and fertility history.

Trends in disposable product use over time

This part of the study uses trade data obtained from Global Trade Information Systems to estimate the level and pace of growth in the use of purchased, disposable menstrual management products. Since import data are not available for most LI and LMI countries, we use data on exports to these countries as reported by trading partners. Because data on the value of products manufactured and used domestically are not available, we assume that if a country did not report any exports of sanitary products, it did not manufacture any, and restrict the analysis to those LI and LMI countries that imported, but did not report exporting, any menstrual hygiene products. Data for a total of 84 of 96 LI and LMI countries are in the sample of countries for which records of menstrual hygiene product imports exist. Of these, we exclude 17 countries that reported exporting these products. For this part of the analysis, we classify the remaining 67 countries into three income categories: least developed countries (LDC) (income per capita <$992), other LI countries (income per capita $992–1005), and LMI (income per capita $1,006–3,975).

The level of detail in product category reported varies across countries. We use the broad category, 'sanitary napkins and tampons, diapers and diaper liners for babies, and similar sanitary articles with wadding', as this allows us to provide information on the trajectory of product imports for the largest number of countries. While this category clearly includes goods unrelated to menstruation, the inappropriate disposal

of diapers may raise similar issues as menstrual products for sanitation systems. Starting in 2002, the data allow us to disaggregate the broad product category into more narrowly defined categories, including 'sanitary napkins, diapers and sanitary articles of paper'. However, this disaggregation also includes a catch-all category called 'other', which may include some menstrual management products, but had slower growth than other categories. In addition to the broad category analyses, the authors also created upper and lower bound estimates (from 2002 onward) by including or excluding the 'other' category. The results found are robust to the inclusion of bounds and do not change the trends observed. Results are available upon request.

Results

What is the magnitude of the need for MHM solutions in LI and LMI countries?

Table 2 presents regional estimates of the proportion and number of regularly menstruating women between ages 15 and 49 by age category and region. Overall,

Table 2 Proportion and number of females menstruating in last six weeks in low-income and lower-middle income countries, by age and region

	Age category		
Region (LI & LMI countries)	*15–19 years*	*20–35 years*	*35–49 years*
Global	0.7513	0.7091	0.7010
(sample size = 1,152,933)	(0.0027)	(0.0013)	(0.0016)
	163,152,604	**390,832,541**	**298,428,708**
Sub-Saharan Africa	0.7234	0.5653	0.6010
(sample size = 460,748)	(0.0026)	(0.0019)	(0.0024)
	30,030,844	**50,824,794**	**28,585,149**
Middle East and North Africa	0.4306	0.5841	0.7512
(sample size = 69,915)	(0.0196)	(0.0038)	(0.0033)
	4,669,797	**15,851,156**	**12,337,174**
South Asia	0.8652	0.7825	0.6920
(sample size = 195,874)	(0.0027)	(0.0021)	(0.0030)
	65,695,652	**148,114,856**	**88,731,684**
East Asia	0.6823	0.7215	0.7320
(sample size = 102,483)	(0.0253)	(0.0035)	(0.0036)
	54,811,408	**159,098,432**	**161,004,693**
Latin America and Caribbean	0.8506	0.7208	0.7094
(sample size = 126,831)	(0.0025)	(0.0022)	(0.0029)
	3,328,134	**6,547,539**	**4,018,094**
Europe & Central Asia	0.8724	0.7967	0.8101
(sample size = 62,986)	(0.0047)	(0.0041)	(0.0052)
	4,034,764	**9,958,872**	**8,442,003**

Note: Global proportions are based on DHS data and are weighted using regional weights based on World Bank population estimates for each age group and region. Regional proportions are based on country weights based on population estimates for each age group and country in the region. Standard errors for proportions are in parentheses. Numbers of women menstruating in each category are in bold and are estimated by multiplying weighted proportion by World Bank population estimates for women in each age and region category.

more than 800 million women (67 per cent of women in this age group) are menstruating. The table reveals differences in menstruation patterns across regions and shows the age groups among which the greatest need for menstrual products and facilities exist. Adolescent girls (15–19 years old) have the highest share reporting menstruating in the past 6 weeks in all regions except for East Asia and the Middle East/North Africa. The proportion of women menstruating also varies with urban versus rural residence (Table 3). Urban women are 8 percentage points more likely to have menstruated in the past 6 weeks than rural women (77 per cent compared with 69 per cent), though the number of menstruating women is higher in rural areas than urban (507 million compared with 352 million), reflecting the relatively higher rural population in LI and LMI countries. Overall and within region, likelihood of menstruation increases with wealth (globally 61 per cent of the poorest quintile menstruate compared with 78 per cent of the wealthiest) (Table 4).

Table 3 Proportion of females menstruating in last six weeks in low-income and lower-middle income countries, by urban vs. rural residence

	Residence	
	Urban	*Rural*
Global (LI and LMI countries)	0.7671	0.6899
(sample size = 1,024,412)	(0.0013)	(0.0016)

Note: Global proportions are based on DHS data and are weighted using regional weights based on World Bank population estimates for each age group and region. Standard errors for proportions are in parentheses.

Table 4 Proportion of females menstruating in last six weeks in low-income and lower-middle income countries, by wealth quintile

Wealth quintile	*Global (LI and LMI countries)*
Poorest	0.6085 (0.0022)
Poorer	0.6402 (0.0019)
Middle	0.6753 (0.0019)
Richer	0.7155 (0.0017)
Richest	0.7826 (0.0017)

Note: Sample size = 1,024,412. Global proportions are based on DHS data and are weighted using regional weights based on World Bank population estimates for each age group and region. Standard errors for proportions are in parentheses.

Table 5 Proportion and number of females menstruating in last six weeks in low-income and lower-middle income countries, by sanitation facility use

Region	*Sanitation facility*			
	Flush toilet	*Pit latrine*	*No facility*	*Other*
Global (developing regions)	0.7523	0.6656	0.6813	0.7046
	(0.0016)	(0.0014)	(0.0012)	(0.0075)
	473,820,688	**156,751,561**	**210,233,714**	**13,361,409**
Sub-Saharan Africa	0.7900	0.6214	0.5197	0.7029
(LI & LMI countries)	(0.0031)	(0.0014)	(0.0018)	(0.0098)
	12,259,135	**64,574,628**	**29,970,355**	**1,308,400**
Middle East and North Africa	0.6029	0.5526	0.4605	0.5315
(LI & LMI countries)	(0.0043)	(0.0156)	(0.0073)	(0.0146)
	27,487,501	**874,883**	**2,693,296**	**734,485**
South Asia (LI & LMI countries)	0.7873	0.7248	0.7269	0.6535
	(0.0021)	(0.0040)	(0.0023)	(0.0101)
	160,143,623	**40,693,122**	**91,059,777**	**5,656,491**
East Asia (LI & LMI countries)	0.7447	0.6863	0.7112	0.7032
	(0.0044)	(0.0233)	(0.0046)	(0.0211)
	261,935,970	**35,292,046**	**78,110,251**	**5,605,521**
Latin America and Caribbean	0.8312	0.7552	0.6468	0.7081
(LI & LMI countries)	(0.0032)	(0.0024)	(0.0043)	(0.0382)
	3,832,666	**7,642,303**	**2,511,683**	**33,034**
Europe & Central Asia	0.8698	0.7223	0.5694	0.8077
(LI & LMI countries)	(0.0033)	(0.0033)	(0.0047)	(0.0223)
	7,798,819	**8,895,712**	**3,460,042**	**151,293**

Note: See Table A.2 for sample sizes. Global proportions are based on DHS data and are weighted using regional weights based on World Bank population estimates for each age group and region. Standard errors for proportions are in parentheses.

Table 5 presents the proportion of regularly menstruating women by the type of sanitation system primarily used. Globally, and across regions, women who have access to flush toilets are the most likely to be menstruating (globally, 75 per cent of women with flush toilets are menstruating compared with 67–70 per cent of women in the other sanitation categories). In terms of absolute numbers, too, the majority of menstruating women globally come from households with access to flush toilets, due largely to the high proportion of women in very populous regions of East and South Asia who have access to flush toilets. Globally, we estimate that 474 million women aged 15–49 in LI and LMI countries with access to flush toilets are regularly menstruating, compared with 157 million women using pit latrines and 210 million women with no facility. However, regional variation in the distribution of households across the systems yields very different patterns in the absolute numbers of menstruating women by sanitation type; see Table A.2 for distribution of sanitation systems by region. For example, in sub-Saharan Africa, where only 8.67 per cent of households have access to flush toilets while the majority use pit latrines (58 per cent) or no facility (32 per cent), relatively few menstruating women use

flush toilets. A similar pattern is reflected in Latin America and the Caribbean and Europe and Central Asia.

What is the likely trajectory of this need?

Variations in pregnancy patterns explain most of the variation in menstruation rates across regions and sub-populations. For example, the lower rate of menstruation for adolescents in the Middle East and North African region appears to be largely due to the much higher rate of pregnancy among adolescent girls in this region (21 per cent compared with the global average of 9.6 per cent). When pregnant women are removed from the analysis, the proportion of adolescents who have menstruated in the past 6 weeks is very similar to the overall proportion for that age group (93 per cent compared with 95 per cent, globally). This suggests that changes in fertility over time will be the biggest driver of changes in the need for products and facilities to manage menstruation.

Pregnancies do not explain all of the variation, however. In sub-Saharan Africa, for example, even among age groups for which pregnancy rates are lower than in other regions, the probability of menstruation is lower. While unknown or unreported pregnancies and breastfeeding may account for part of this difference, nutritional status may also contribute. Body mass index (BMI) is positively correlated with likelihood of menstruation (p-value <0.0001) and anaemia status is negatively correlated with likelihood of menstruation (p-value <0.0001). Regression estimates reported in Table 6 show that nutritional status plays an important role in the likelihood of regular menstruation among non-pregnant women, controlling for age, fertility history, country, and year. Anaemic women (Hb <7.0 g/dL) were 2.4–2.6 percentage points less likely to have menstruated in the past 6 weeks than women who were not anaemic. Likewise, BMI has a positive and significant effect on the likelihood of menstruating, controlling for covariates. The magnitude of the effect implies that if a woman's BMI falls from 18.5 to 17.5, her likelihood of menstruation would fall by 6 percentage points.

Table 6 Association of BMI and anaemia status with likelihood of menstruating in the past six weeks

	No year or country-specific dummies	*Includes year-specific dummies, no country dummies*	*Includes 5-year dummies and country dummies*
BMI	0.00881[1]	0.00800[1]	0.00488[1]
	(0.00040)	(0.00041)	(0.00038)
BMI squared	–0.00007[1]	–0.00007[1]	–0.00004[1]
	(0.00000)	(0.00000)	(0.00000)
Severely anaemic	–0.02389[1]	–0.02557[1]	–0.02399[1]
(Hb<7.0g/dL)	(0.00778)	(0.00775)	(0.00776)
R-Squared	0.152	0.157	0.168

Note: Sample size is the same across all regressions = 383,150. Dependent variable: menstruated in past six weeks. Other controls include woman's age, age squared, number of births in last five years, and number of children.
1 indicates significant at the 1% level. Standard errors in parentheses.

What are current trends in disposable menstrual management product use?

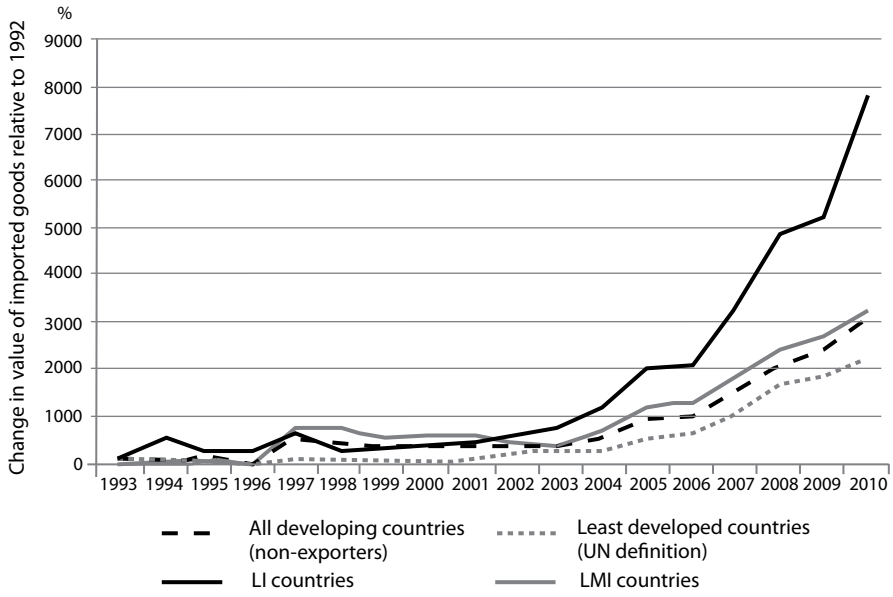

Figure 1 Growth (percentage change relative to 1992) in purchased non-biodegradable products (including sanitary napkins and tampons, diapers and diaper liners for babies, and similar sanitary articles with wadding)

Figure 1 illustrates the growth from 1992 to 2010 in the value of this broad category of imports, for all developing countries combined (LDC, other LI countries, and LMI), as well as for these three mutually exclusive categories. Between 1992 and 2010, the value of MHM product imports to developing countries increased by 3,000 per cent. Imports were relatively stable in all of the country groupings between 1992 and 2003, after which time their value increased exponentially. Even in LDCs, where the pace of growth has been slower, the value of imports grew by 2,000 per cent in this period.

However, as revealed by Figure 2 (which presents the annual US dollar value of imports per female aged 15–49), this explosion in growth begins from a very low base. The lower bound estimate for average expenditures on menstrual products per female aged 15–49 is only $1.26 for LDCs in 2010, the most recent year for which data are available. Including other disposable absorptive products such as diapers increases this value to $2.06. These values are $5.81 and $6.00, respectively, for LMI countries, where growth in their usage has been the most dramatic.

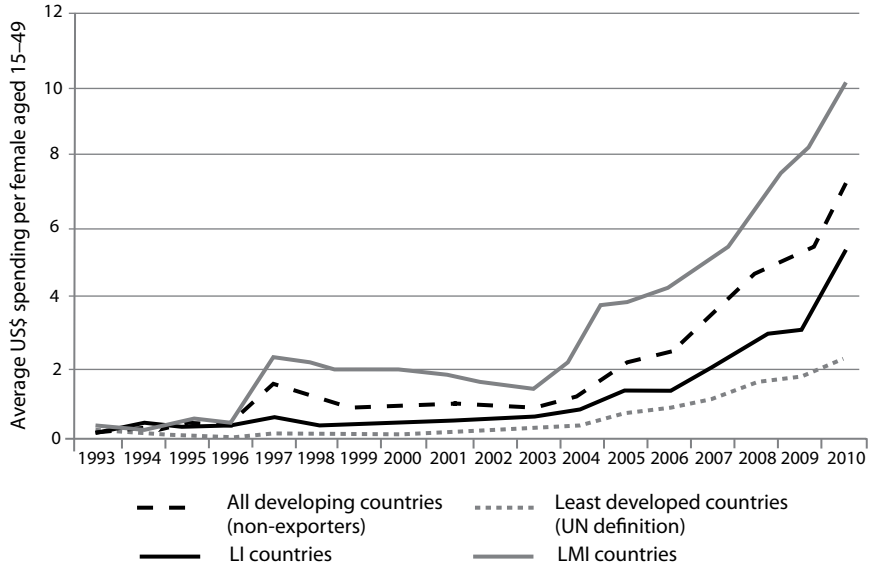

Figure 2 Level changes in purchased non-biodegradable products (including sanitary napkins and tampons, diapers and diaper liners for babies, and similar sanitary articles with wadding)

Discussion

The results above show that the majority of women of reproductive age in LI and LMI countries, over 800 million women, are currently menstruating. Variations in proportion and number of women menstruating exist across regions and across sub-populations within these regions, with the likelihood of menstruating increasing among wealthier women and women in urban settings (though there are more rural women menstruating in absolute numbers). As noted in the methods section, this analysis may not capture all menstruating populations in LI and LMI countries, which could impact these results. The DHS collects data on menstruation only for women and girls age 15 and above, whereas the average age of menarche may be as low as 12 years (Thomas et al., 2001). Thus the absolute numbers of women menstruating are likely understated, particularly in regions with earlier menarche.

Earlier menarche is correlated with increased life expectancy, improved nutrition, and literacy (Thomas et al., 2001), suggesting that underestimation may be more severe in regions with these characteristics.

Menstruation patterns are affected by variations in nutritional status, but the effects of fertility are stronger. For example, for the two countries in our sample with the largest difference in mean BMI, Congo (Brazzaville) at 32.49 and Guinea at 21.64, the resulting difference in likelihood of menstruation is 3.05 percentage points (calculated at the mean for other covariates). Similarly, the difference in

likelihood of regular menstruation between the country with the largest proportion of severely anaemic women (Guinea, 2.67 per cent and the country with the smallest proportion (Swaziland, 0.39 per cent would be 4.54 percentage points. In contrast, the greatest difference in pregnancy rates is between Swaziland (14.86 per cent and Lesotho (4.4 per cent, a gap that translates into a 10.5 percentage point difference in the likelihood of menstruation.

An implication of these findings is that predictions about the evolution of female fertility and nutritional status over time may be used to forecast changes in the number of women requiring facilities to deal with menstrual hygiene and waste disposal. In particular, if female nutritional status continues to improve and fertility rates continue to decline (World Bank data, 2012), demand for menstrual management products and facilities is likely to increase.

Other factors not considered in this analysis may also explain some of the variation in menstruation across countries and sub-populations. For example, unknown and unreported pregnancies could explain some variations in menstruation that were not explained by reported pregnancy. These pregnancies could impact nutritional status (for example, increased iron requirements during pregnancy increase the likelihood of anaemia; Allen, 1997, hence overstating the impact of nutritional status on menstruation rates. Additionally, breastfeeding can lead to amenorrhoea. Variations in breastfeeding practices across regions and sub-populations may also explain some of these patterns.

As addressing women's menstrual hygiene needs can vary by sanitation system, this study explores menstruation patterns by sanitation system and region. This analysis has shown that flush toilets are the system most commonly used by menstruating women in LI to LMI countries worldwide, driven mostly by the relatively large share of menstruating women using flush toilets in East and South Asia, but that pit latrines predominate in sub-Saharan Africa (58 per cent and Latin America (54 per cent. It should also be noted that a relatively large proportion of households in sub-Saharan Africa and South Asia do not have access to any sanitation facilities (32 per cent in each region, a particular concern with respect to privacy during menstruation. More recent statistics on sanitation coverage from the WHO and UNICEF Joint Monitoring Programme report suggest similar results to ours (WHO/UNICEF, 2012). The report shows a more pronounced lack of sanitation, open defecation of 41 per cent in South Asia and, somewhat lower, 25 per cent open defecation in sub-Saharan Africa (WHO/UNICEF, 2012). Although this statistic has declined by 11 per cent since 1990 in sub-Saharan Africa, according to the report, the number of people practising open defecation in that region has increased by 33 million as a result of population growth, mostly in rural areas (WHO/UNICEF, 2012). Statistics from the JMP 'Progress on drinking water and sanitation: 2012 update' are consistent with our findings and reveal a need for expanded access of improved sanitation systems to increase privacy for girls and women in these regions.

Globally, over 12 billion pads and tampons are disposed of annually, with the average woman producing 125–150 kg of disposable menstrual waste in her lifetime (Bharadwaj and Patkar, 2004). Failure to provide good options for menstrual waste disposal may lead to pressure on sanitation systems. Anecdotal evidence suggests

that menstrual waste (including disposable and potentially reusable products) is disposed of in toilets and latrines (Bharadwaj and Patkar, 2004, Kjellen et al., 2011, Sommer, 2011), often because there are no other options. A recent study by the Stockholm Environmental Institute found that flush systems were the most vulnerable type of system to sanitation waste (Kjellen et al., 2011). For example, the study reports that the Dar es Salaam Water and Sewerage Corporation (Tanzania) records an average of 150 blockages per month at a cost of $25,000 per month, with menstrual pads, tampons, and rags found among material commonly creating these blockages. Mavoko Water and Sewerage Company in Kenya finds menstrual pads contributing to roughly 40 per cent of material removed from blocked sewers, and the Manila Water Company in the Philippines finds an average of four blockages a day caused mostly by menstrual pads, diapers, rags, and similar materials (Kjellen et al., 2011). Overall, the study finds that disposable menstrual products contribute to 30–90 per cent of sewage blockages in the LI and LMI countries discussed.

While system failure is mostly a concern for women using flush toilets, proper waste disposal and privacy are still a concern for women using pit latrines or who do not use any formal facility (Sommer, 2011). In a survey conducted in urban slums in Delhi, India, 92 per cent of respondents were found to dispose of cloths used during menstruation (Kjellen et al., 2011). The authors postulate that quantities of menstrual management products disposed of in pit latrines in slums and peri-urban settings are higher than in rural areas. Their primary explanation is that rural women reuse cloth, whereas in slums, because of a lack of space and privacy, this practice is not prevalent. Menstrual waste reduces the design life of pit latrines and the problem of fill up is more acute when several families are sharing the facility. Additionally, the non-biodegradable nature of rags and plastic inlays from menstrual pads can pose problems if pit latrine sludge is used on farmland (Kjellen et al., 2011). Removing non-biodegradable matter from sludge increases costs to rural agricultural households. In urban settlements, the technology used to empty pit latrines is often not powerful enough to completely empty pits or deal with non-biodegradable matter (Kjellen et al., 2011). According to the study, the Lusaka Water and Sewerage Company in Zambia reports blockages in 80 per cent of pit emptying jobs, with menstrual products contributing to blockages 25 per cent of the time. These reports highlight that providing appropriate facilities for washing or disposal of menstrual waste for all women is important, regardless of the type of sanitation facility used.

With respect to the imports of disposable menstrual management products into LI and LMI countries, if present growth rates continue, usage of disposable menstrual product in least developed and low-income countries will increase significantly in the coming years and decades. It should be noted that the analysis above presents changes in disposable product use *on average* and does not imply that use will increase for all women. Thus in most cases it is unclear from this analysis which women within a region are using disposable products or the types of sanitation systems that subsequently may be impacted.

In addition to the trade trends discussed above, recent government initiatives in some countries may also contribute to increased use of disposable menstrual management products. In India the Ministry of Health has approved a programme

that would distribute sanitary napkins to adolescent rural girls at a nominal cost. In the first phase of this scheme up to 1.5 million girls aged 10 to 19 in 152 districts are expected to gain access to sanitary napkins (SWETA, 2010; *The Tribune*, 2011). However, it is unclear how access to toilets in schools, water, and mechanisms for safe disposal will be addressed under this programme. South Africa has also launched a campaign to provide poor women and girls with free sanitary napkins. For example, in 2010, the Northern Cape Provincial Government distributed 50,000 napkins to school-going girls and women in the province (Northern Cape Provincial Government , 2010) and the campaign is expected to expand across the country. While expanding the options for MHM available to low-income women is a positive development, the burden on sanitation systems should be taken into account and appropriate facilities provided.

Conclusion

Over 800 million women in low and lower-middle income regions of the world menstruate regularly, implying a widely felt need for menstrual hygiene-appropriate sanitation facilities, and an enormous potential market for disposable menstrual products. While much of the demand for such products remains latent, as women repurpose discarded clothing and other cloth to absorb menstrual flow, the market for disposable menstrual products is growing rapidly. New government policies in middle-income countries such as India and South Africa making menstrual products freely available to poor women promise to further fuel the rapid expansion of this market.

Our analysis correlating menstruation with fertility and indicators of nutritional status sheds light on the likely evolution of need for menstrual solutions over time, as fertility falls, incomes increase, and nutrition improves. Information on the number of menstruating women using various types of sanitation by region suggests where efforts to address the interactions between menstrual management practices and sanitation systems, in particular waste disposal, might be most effectively targeted. Finally, data on the trajectory of menstrual product imports by least developed, other low-income, and lower-middle income countries can be used as a basis for projections of global growth in the use of disposable menstrual products, and the corresponding need for development of waste disposal systems.

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Appendix

Table A.1 Availability of DHS data for low-income and lower-middle income countries

Region	*Proportion of countries for which DHS data available*	*Proportion of regional population represented by DHS data*	*Proportion of LI and LMI population represented by region*
Global (developing regions)	0.60 (58/96)	0.64	1.00
Sub-Saharan Africa	0.73 (29/40)	0.71	0.15
Middle East and North Africa	0.56 (5/9)	0.74	0.05
South Asia	0.75 (6/8)	0.54	0.33
East Asia	0.30 (6/20)	0.26	0.43
Latin America and Caribbean	0.80 (8/10)	0.99	0.02
Europe and Central Asia	0.44 (4/9)	0.84	0.02

Table A.2 Distribution of sanitation systems by region from DHS sample

Category	*Description*	*Proportion of households with access (%)*						
		Sub-Saharan Africa	*Middle East & North Africa*	*South Asia*	*East Asia*	*Latin America & Caribbean*	*Europe & Central Asia*	*Global*
Flush toilet	Own flush toilet; shared flush toilet; traditional bucket flush; flush to-pipe sewer, septic tank, latrine, elsewhere; flush toilet connection w/ open water; flush connected to river/creek	8.67 (19,431)	83.80 (45,066)	51.70 (76,081)	67.51 (43,757)	24.71 (16,373)	32.55 (15,886)	44.82 (21,6594)
Pit latrine	Pit toilet latrine; traditional pit; ventilated improved pit (VIP) latrine; septic pit; pit w/ slab; pit without slab	58.06 (130,125)	2.91 (1565)	14.27 (20,994)	9.87 (6397)	54.23 (35,939)	44.71 (21,824)	30.68 (216,844)
No facility	No facility; bush; forest; yard; field; open air; river, stream, creek	32.22 (72,192)	10.75 (5782)	31.84 (46,852)	21.08 (13,665)	20.81 (13,793)	22.06 (10,765)	23.13 (163,049)
Other	Hanging toilet; bucket toilet; composting toilet; other	1.04 (2336)	2.54 (1366)	2.20 (3235)	1.53 (993)	0.25 (168)	0.68 (332)	1.37 (8430)

Note: numbers in parentheses indicate sample size