

Menstrual hygiene management among adolescent girls in India: a systematic review and Meta-Analysis

Supplement 1: Methodology and Quality assessment

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Table S1.1: PICOT table PubMed

Framework	Search terms	Number of articles
P Population	(adolescent OR adolescence OR puberty OR peer OR school)	P: 3,922,974
I Intervention or condition	AND (Menstruation OR menstrual OR menses)	I: 20,899 P+I: 16382
C Control	-	
O Outcome	AND (hygiene OR hygienically OR sanitation OR sanitary)	O: 112,907 P+I+O: 397
T Timing	AND ("2000/01/01"[PDat] : "2015/01/31"[PDat])	P+I+O+T: 32
S Setting	AND India	S: 252,289 P+I+O+T+S: 24

Search date: 2 February 2015, 24 articles

Table S1.2: PICOT table Global Health Database

Framework	Search terms	Number of articles
P Population	(adolescent OR adolescence OR puberty OR peer OR school)	P: 374,759
I Intervention or condition	AND (Menstruation OR menstrual OR menses)	I: 5912 P+I: 1447
C Control	-	
O Outcome	AND (hygiene OR hygienically OR sanitation OR sanitary)	O: 295,839 P+I+O: 176
T Timing	AND ("2000-2015")	Custom range
S Setting	AND India	S: 176,436 P+I+O+T+S: 34

Search date 2 February 2015, 34 Articles

Google Scholar: Search date 2 February 2015, 21 Articles (sort by date) (Menstruation OR menstrual OR menses) AND (adolescent OR adolescence OR puberty OR peer OR school) AND (hygiene OR hygienically OR sanitation OR sanitary) AND India, custom range 2000-2015: > 20,000 results, screened pages until saturation (2 pages without new references). This occurred after 8 pages.

The search was repeated on 19 September 2015 for the year 2015, when 20 new references were added.

Table S1.3: Elements of the data extraction form for the review on menstrual hygiene management among adolescent girls in India, studies published between 2000 and 2015

	Description	Notes
	Characteristics of material: first author, year, type of material (article, report) Characteristics of study: design, sample size, location, study period, urban or rural, study population, who administered questionnaire, time	
1	Inclusion and exclusion criteria, sample size An indicator of age of the study population	Mean, sd, or median and IQR, or range, or groups
2	An indicator of SES, religion, maternal education or other	
3	An indicator of menarche	Mean, sd, or median and IQR, or range, or groups
4	Menarche: Knowledge of menarche, source of information, reaction to menarche	
5	Material used for period: cloth, pads, both, how disposed, how cleaned, reuse, changing, how often, where	
6	Hygiene during period: baths, washing habits, soap use, frequency	
7	Restrictions during period: related to religion, touching, cooking, sitting or sleeping in house, getting out of the house, diet, physical activities, schooling/education, household work, family functions, type of clothing, interactions with boys, personal hygiene, other, none	
8	Knowledge about period: where does blood come from, is it normal, what is the reason for the period, what is the normal duration, etc	
9	Perception of period: debilitating, bothersome, or no negative effect on women's performance	
10	Menstrual problems: dysmenorrhoea (pain), irregular, other	
11	External problems: toilet situation at school or at home, school absenteeism, privacy, other	
12	Any associations reported	
13	Qualitative information	
14	Interventions described	
15	Boys and menstruation	
16	Any other issues	
17	Reference check	

Section SI.4: Additional information on data synthesis

A considerable proportion of studies did not report when the study was conducted. We calculated the median difference between publication and year of study for the studies where this was known (median was 2 years in 67 studies), and extrapolated this difference to 51 studies with unreported time of study. To assess time trends the year of study was recorded; for studies covering more than one year, the last year was used in order to be consistent with the studies where we extrapolated the period of study. Not all studies had information for all the components we examined in the framework, and some studies presented a wealth of information. We focussed on certain variables related to knowledge, attitude and practice, and sources of information with regards to menstrual hygiene, based on reliability, reporting frequency, and perceived importance by the review authors. The following outcomes were selected for further analysis based: awareness of menarche before the start of menstruation, and sources of the awareness; knowledge of source of bleeding, perception of menstruation as a normal phenomenon, resources for menstruation, type of absorbent used, disposal of absorbent, daily bath during period, restrictions reported, and school absenteeism during the menstruation.

For meta-regression, study-level predictors were considered for inclusion in the initial models if the p-value for the univariate association of that variable with the endpoint was <0.2 . Backwards elimination was conducted whereby variables were removed if the p-value was > 0.1 or all p-values for the individual levels were >0.1 in the multivariate model. We examined for interaction if there was more than one variable in the main model.

Section S1.5: Quality assessment

Quality-assessments of included studies were conducted by the same reviewers based on the following criteria: presence of a sample size calculation, randomness of sample, description and appropriateness of inclusion and exclusion criteria, presence of a description of the number of persons approached but not enrolled, or enrolled but data not used, completeness of outcome data for the number which was presented, presence of study characteristics and of multivariate analysis for the outcome of the paper. To score for randomness of sample, some description of the process was required. With regards to study characteristics, at least 3 of the four following components were expected to be present: year of conduct of the study, location of the study, an indicator of age of the participants, and another characteristic of the participants, such as socio-economic status, parental education, religion, or type of family (nuclear, extended or joint). A study did not receive a score of 1 for this item if two or more of these components were missing. A study was considered moderate-to-good, if at least 5 criteria had been satisfied.

Table S1.6: Summary of quality assessment of 138 included studies on MHM, India, 2000 to 2015

Variable	Values	Number (%)	
Sample size calculation present	Yes	35	(25.4)
	No	102	(73.9)
	Not applicable	1	(0.7)
Random sample	Yes	40	(29.0)
	No	98	(71.0)
Inclusion and exclusion criteria described and adequate	Yes	62	(55.1)
	No	76	(55.1)
Denominator or refusals or incomplete forms reported?	Yes	26	(18.8)
	No	112	(81.2)
Complete outcome data	Yes	138	(100)
	No	0	
Characteristics presented	Yes	96	(69.6)
	No	42	(30.4)
Multivariate analysis done	Yes	14	(10.1)
	No	124	(90.0)
Quality	Score > 4	27	(19.6)
	Score ≤4	111	(80.4)
Mean score (standard deviation)		3	(1.5)

Table S1.7: Individual quality assessment of 138 sources included in the review of the status of menstrual hygiene management among adolescent girls in India, studies published between 2000 and 2015

Author/year, type of material	Sample size calculation present	Inclusion/exclusion criteria described and adequate for study purpose	Random sample	Loss to enrolment or incomplete data described	Complete outcome data for included participants	Characteristics described (age, year of study, location)	Multivariate analysis conducted for study outcome	Assessment quality for review
Ade 2013 ¹	0	1	0	0	1	1	0	3
Amirtha 2013 ²	0	0	0	0	1	1	0	2
Anand 2015 ³	0	1	1	1	1	1	1	6
Anitha 2015 ⁴	0	0	0	0	1	0	0	1
Anuradha 2000 ⁵	1	1	1	0	1	1	1	6
Anusree 2014 ⁶	0	0	0	0	1	1	0	2
Arora 2013 ⁷	0	1	1	1	1	1	0	5
Arunmozhi 2013 ⁸	1	1	1	0	1	1	0	5
Audinarayana 2005 ⁹	0	1	0	0	1	1	1	4
Avachat 2011 ¹⁰	0	0	0	0	1	1	0	2
Avasarala 2008 ¹¹	0	0	0	0	1	0	0	1
Balasubramanian 2005 ¹²	0	0	0	0	1	1	0	2
Barathalakshmi 2014 ¹³	1	1	0	0	1	1	0	4
Baridalyne 2004 ¹⁴	0	1	1	0	1	1	0	4
Bathija 2013 ¹⁵	0	1	0	0	1	1	0	3
Bhattacharjee 2013 ¹⁶	1	1	1	1	1	1	0	6
Bhore 2014 ¹⁷	0	0	0	0	1	1	0	2
Bhudhagaonkar 2014 ¹⁸	0	1	0	0	1	1	0	3
Bobhate 2011 ¹⁹	0	1	0	0	1	1	0	3
Bodat 2013 ²⁰	0	1	0	0	1	1	0	3
Boratne 2014 ²¹	1	1	0	1	1	1	0	5
Borker 2014 ²²	0	0	1	0	1	1	0	3
Chothe 2014 ²³	0	0	0	1	1	0	0	2
Dambhare 2012 ²⁴	0	1	0	1	1	1	0	4
Dasgupta 2008 ²⁵	0	0	0	0	1	1	0	2
Datta 2012 ²⁶	0	1	1	1	1	1	0	5
Deo 2007 ^{27,28}	0	1	0	0	1	0	0	2
Dhingra 2009 ²⁹	0	0	0	0	1	1	0	2
Dongre 2007 ³⁰	1	1	1	1	1	1	0	6
Dube 2012 ³¹	0	0	0	0	1	0	0	1
Dugani 2015 ³²	0	0	0	0	1	1	0	2
Dutta 2006 ³³	0	1	0	0	1	1	0	3
Garg 2001 ³⁴	0	0	0	1	1	1	0	3
Goel 2011 ³⁵	1	0	0	0	1	0	0	2
Gosavi 2015 ³⁶	0	0	0	0	1	1	0	2
Gujarathi 2014 ³⁷	0	0	0	0	1	0	0	1
Gupta 2001 ³⁸	0	0	0	0	1	1	0	2
Gupta 2006 ³⁹	0	0	0	1	1	1	0	3
Jain 2009 ⁴⁰	1	0	0	0	1	0	0	2
Jain 2012 ⁴¹	0	1	0	0	1	0	0	2
Jogdand 2011 ⁴²	0	1	1	0	1	0	0	3
Jothy 2012 ⁴³	0	0	0	0	1	1	0	2
Juyal 2013 ⁴⁴⁻⁴⁶	1	0	1	0	1	1	0	4
Jyothi 2005 ⁴⁷	0	0	1	0	1	0	0	2
Kale Kalpana 2014 ⁴⁸	0	1	0	1	1	0	0	3
Kamaljit 2012 ⁴⁹	0	0	0	0	1	1	0	2
Kamath 2013 ⁵⁰	1	0	1	0	1	1	0	4
Kanotra 2013 ⁵¹	0	0	0	0	1	0	0	1
Katiyar 2013 ⁵²	1	0	0	0	1	1	0	3
Katkuri 2014 ⁵³	0	0	0	0	1	1	0	2
Kavitha 2012 ⁵⁴	0	0	0	0	1	0	0	1
Kendre 2013 ⁵⁵	0	0	1	1	1	1	0	4
Khan 2012 ⁵⁶	0	1	1	0	1	1	0	4
Khanna 2005 ⁵⁷	0	0	1	1	1	1	1	5
Kumar 2011 ⁵⁸	0	0	0	0	1	0	0	1
Kumar 2012 ⁵⁹	1	1	0	1	1	1	0	5
Kumar 2013 ⁶⁰	1	1	1	0	1	1	0	5
Kumar 2015 IJCRR ⁶¹	1	0	0	0	1	1	0	3
Kumar 2015 IMG ⁶²	0	1	0	0	1	0	0	2
Kumari 2014 ⁶³	0	0	0	0	1	0	0	1

Author/year, type of material	Sample size calculation present	Inclusion/exclusion criteria described and adequate for study purpose	Random sample	Loss to enrolment or incomplete data described	Complete outcome data for included participants	Characteristics described (age, year of study, location)	Multivariate analysis conducted for study outcome	Assessment quality for review
Kushwah 2007 ⁶⁴	0	0	0	0	1	1	0	2
Lakshmi 2013 ⁶⁵	0	0	0	0	1	0	0	1
Lalbiaknungi 2015 ⁶⁶	0	1	0	0	1	1	0	3
Leuva 2014 ⁶⁷	0	1	0	0	1	1	0	3
Mahajan 2004 ⁶⁸	0	0	0	0	1	0	0	1
Mallesappa 2011 ⁶⁹	1	1	1	0	1	1	0	5
Manhas 2015 ⁷⁰	0	0	1	0	1	0	0	2
Manjula 2012 ⁷¹	1	0	1	0	1	0	0	3
Mehta 2013 ⁷²	0	0	0	0	1	1	0	2
Minhas 2014 ⁷³	0	1	0	0	1	0	0	2
Misra 2013 ⁷⁴	1	1	1	1	1	1	0	6
Mittal 2010 ⁷⁵	1	0	0	0	1	0	0	2
Mudey 2010 ⁷⁶	0	1	0	1	1	0	0	3
Nagamani 2014 ⁷⁷	0	1	0	0	1	1	0	3
Nagar 2010 ⁷⁸	0	0	1	0	1	1	0	3
Nair 2007 ⁷⁹	0	1	0	0	1	1	0	3
Nair 2012 ⁸⁰	0	1	1	0	1	0	0	3
Narayan 2001 ⁸¹	0	0	0	1	1	0	1	3
Nemade 2009 ⁸²	0	0	0	0	1	0	0	1
Nielsen 2012 Jaunpur ⁸³	1	1	1	0	1	1	0	5
Nielsen 2012 Mirzapur ⁸⁴	1	1	1	0	1	1	0	5
Nielsen 2012 Sonebhadra ⁸⁵	1	1	1	0	1	1	0	5
Nielsen 2013 East Singhbhum ⁸⁶	1	1	1	0	1	1	1	6
Nielsen 2013 Gumla ⁸⁷	1	1	1	0	1	1	1	6
Nielsen 2013 Nalanda ⁸⁸	1	1	1	0	1	1	1	6
Nielsen 2013 Vaishali ⁸⁹	1	1	1	0	1	1	1	6
Omidvar 2010 ⁹⁰	0	0	0	0	1	1	1	3
Omidvar 2011 ⁹¹	0	1	0	0	1	1	0	3
Padhy 2013 ⁹²	0	0	0	0	1	1	0	2
Pandit 2014 ⁹³	0	1	1	1	1	1	0	5
Parameaswari 2014 ⁹⁴	1	1	1	0	1	1	0	5
Paria 2014 ⁹⁵	0	1	0	0	1	1	0	3
Parwej 2005 ⁹⁶	1	0	1	0	1	1	1	5
Patavegar 2014 ⁹⁷	1	1	0	0	1	1	0	4
Pathak 2015 ⁹⁸	0	0	0	0	1	0	0	1
Patil 2013 ⁹⁹	0	1	0	0	1	0	0	2
Patle 2014 ¹⁰⁰	1	0	0	0	1	0	0	2
Pokhrel 2014 ¹⁰¹	0	1	0	1	1	1	0	4
Preeti 2015 ¹⁰²	0	0	0	0	1	1	0	2
Premila 2015 ¹⁰³	0	0	0	0	1	1	0	2
Prerana 2015 ¹⁰⁴	0	1	0	0	1	1	0	3
Puri 2006 ¹⁰⁵	0	0	1	0	1	0	0	2
Raddi 2010 ¹⁰⁶	0	0	0	0	1	1	0	2
Rana 2015 ¹⁰⁷	1	1	1	0	1	1	0	5
Rani 2014 ¹⁰⁸	0	0	0	0	1	1	1	3
Rao 2008 ¹⁰⁹	1	0	1	0	1	1	0	4
Ravishankar 2011 ¹¹⁰	0	0	0	0	1	1	0	2
Reddy 2005 ¹¹¹	0	0	0	0	1	1	0	2
Salve 2012 ¹¹²	0	0	0	0	1	0	0	1
Sanyal 2008 ¹¹³	0	1	0	0	1	1	1	4
Sarkar 2012 ¹¹⁴	0	1	0	1	1	1	0	4
Sekhon 2014 ¹¹⁵	0	0	0	0	1	1	0	2
Shah 2013 ¹¹⁶	0	1	1	1	1	1	0	5
Shamima 2013 ¹¹⁷	0	1	1	0	1	1	0	4
Shanbhag 2012 ¹¹⁸	0	1	0	0	1	1	0	3
Sharma 2008 ¹¹⁹	0	1	0	1	1	1	0	4
Shetty 2001 ¹²⁰	0	0	0	0	1	1	0	2
Shitole 2012 ¹²¹	0	0	0	0	1	0	0	1
Singh 2006 ¹²²	0	0	0	0	1	0	0	1
Singh 2006_IJCM ¹²³	0	0	0	0	1	0	0	1

Author/year, type of material	Sample size calculation present	Inclusion/exclusion criteria described and adequate for study purpose	Random sample	Loss to enrolment or incomplete data described	Complete outcome data for included participants	Characteristics described (age, year of study, location)	Multivariate analysis conducted for study outcome	Assessment quality for review
Singh 2013 ¹²⁴	1	0	0	0	1	1	0	3
Singh 2015 ¹²⁵	0	0	0	0	1	1	0	2
Solanki 2012 ¹²⁶	0	0	0	0	1	0	0	1
Sudeshna 2012 ¹²⁷	1	1	1	1	1	1	1	7
Sumana 2015 ¹²⁸	0	0	0	0	1	0	0	1
Susila 2014 ¹²⁹	0	0	0	0	1	1	0	2
Susmitha 2010 ¹³⁰	0	1	0	1	1	1	0	4
Thakre 2011 ¹³¹	1	0	0	0	1	1	0	3
Thakur 2014 ¹³²	0	1	1	0	1	1	0	4
Tiwari 2006 ¹³³	0	0	0	0	1	0	0	1
Udgiri 2010 ¹³⁴	0	0	0	1	1	1	0	3
Unni 2010 ¹³⁵	0	0	0	0	1	0	0	1
Venkatesh 2011 ¹³⁶	0	0	0	0	1	0	0	1
Verma 2011 ¹³⁷	0	0	0	0	1	0	0	1
Verma 2013 ¹³⁸	0	0	0	0	1	1	0	2
Vidya 2013 ¹³⁹	1	1	0	1	1	1	0	5
Zaidi 2015 ¹⁴⁰	0	1	0	0	1	1	0	3
Zanvar 2007 ¹⁴¹	0	0	0	0	1	0	0	1

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Menstrual hygiene management among adolescent girls in India: a systematic review and Meta-Analysis

Supplement 2: Additional tables (subgroup analyses, meta-regression, and summary tables)

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Table S2-1: States where 138 studies were conducted, studies in India published between 2000 and 2015

States (in alphabetical order)	Number	(%)
Andhra Pradesh	8	(5.8)
Arunachal Pradesh	0	
Assam	0	
Bihar	3	(2.2)
Chhattisgarh	0	
Goa	0	
Gujarat	8	(5.8)
Haryana	4	(2.9)
Himachal Pradesh	0	
Jammu & Kashmir	4	(3.6)
Jharkhand	3	(2.2)
Karnataka	18	(13.0)
Kerala	5	(3.6)
Madhya Pradesh	3	(2.2)
Maharashtra	24	(17.4)
Manipur	0	
Meghalaya	1	(0.7)
Mizoram	0	
Nagaland	0	
New Delhi	6	(4.4)
Orissa	1	(0.7)
Puducherry	4	(2.9)
Punjab	6	(4.4)
Rajasthan	4	(2.9)
Sikkim	0	
Tamil Nadu	10	(7.3)
Telangana	3	(2.2)
Tripura	0	
Uttar Pradesh	8	(5.8)
Uttarakhand	2	(1.5)
West Bengal	11	(8.0)
National sample	1	(0.7)

Table S2-2: Subgroup analysis and meta-regression of factors that may affect the prevalence of pre-menarche awareness, studies in India published between 2000 and 2015

Univariate analysis									
Covariate	Type of covariate	No. of Surveys	Pooled Prevalence, % and 95% CI	I², %	Odds ratio & 95% CI for meta-regression	p-value by level	τ²	Variance explained (%)	p-value overall
No covariates		88	48, 43-53	98.6			0.354		
Recruitment of study population	Community	29	38, 31-45	98.4	Reference		0.310	12.6	0.001
	School	53	56, 49-62	98.4	1.52, 1.17-1.97	0.002			
	Other	6	34, 15-55	98.2	0.82, 0.50-1.35	0.426			
Setting of study	Rural	39	45, 38-51	98.0	Reference		0.339	4.2	0.088
	Urban	37	53, 44-62	98.9	1.15, 0.88-1.50	0.310			
	Slum	5	26, 20-33	88.0	0.65, 0.37-1.13	0.127			
	Combination	7	60, 52-68	96.0	1.48, 0.92-2.38	0.107			
Last year of study	Continuous	88			1.04, 1.01-1.07	0.012	0.333	6.2	0.012
	< 2010	32	47, 36-57	99.2	Reference		0.350	1.2	0.158
	≥2010	56	49, 44-54	97.7	1.21, 0.93-1.57	0.158			
Region of study	North	20	39, 28-51	98.7	1.00 Reference		0.333	6.1	0.057
	Central	7	50, 28-73	99.5	1.43, 0.86-2.37	0.165			
	East	15	49, 41-58	97.4	1.51, 1.01-2.24	0.042			
	West	19	61, 49-73	98.6	1.74, 1.20-2.52	0.004			
	South	27	45, 38-52	97.4	1.31, 0.93-1.85	0.115			
Completely or partly adolescents	Completely	79	48, 43-54	98.7	0.95, 0.62-1.45	0.809	0.358	0.0	0.809
	Partly	9	50, 36-64	98.0	Reference				
Self-administered or interview	Self	41	53, 44-61	98.7	1.21, 0.94-1.55	0.146	0.350	1.3	0.146
	Interviewed	37	45, 38-53	98.6	Reference				
Quality score	Continuous	88			0.92, 0.85-1.00	0.049	0.342	3.4	0.049
	>4	19	39, 29-49	98.9	0.71, 0.53-0.96	0.029	0.339	4.4	0.029
	≤4	69	51, 45-57	98.4	Reference				
Study is a random sample	Yes	29	42, 34-50	98.6	0.78, 0.60-1.02	0.073	0.345	2.6	0.073
	No	59	52, 45-58	98.5	Reference				
Multivariate analysis									
Setting of study	Rural	39			Reference		0.271	23.6	0.0004
	Urban	37			1.12, 0.87-1.45	0.369			
	Slum	5			0.59, 0.36-0.98	0.043			
	Combination	7			1.57, 1.00-2.46	0.049			
Region of study	North	18			Reference		0.068	0.012	0.013
	Central	7			1.56, 0.97-2.52	0.068			
	East	14			1.72, 1.13-2.60	0.012			
	West	17			1.55, 1.10-2.19	0.013			
	South	22			1.25, 0.89-1.73	0.190			
Quality score	>4	19			0.65, 0.47-0.89	0.008	1.00		
	≤4	59			1.00				
Last year of study	Continuous	88			1.03, 1.00-1.06	0.026			

Table S2-3: Summary of results of subgroup analysis and meta-regression of other outcomes than awareness in table 2 main manuscript, India, studies published between 2000-2015

Outcome	Total #	Subgroup analysis for variables presented in meta-regression			Multivariate meta-regression (if applicable)*	
Information source on menarche among girls aware of menarche		Variable	#	Pooled prevalence, %, 95% CI	Odds ratio, 95% CI	p-value
Mother	43	<i>Region</i>				
		North India	9	37, 24-52	Reference	
		Central	1	67, 59-74	1.59, 0.73-3.46	0.236
		East	8	59, 50-68	1.45, 0.98-2.13	0.062
		West	14	52, 43-60	1.25, 0.89-1.75	0.192
		South	11	59, 50-67	1.40, 0.97, 2.01	0.071
		<i>Year of study</i>			1.04, 1.00-1.07	0.028
		<i>Random sample</i>				
		Yes	11	41, 33-50	0.75, 0.57-1.00	0.047
		No	32	56, 50-62	Reference	
Friends	37	<i>Region</i>				
		North India	11	34, 26-42	Reference	
		Central	1	9, 5-15	0.31, 0.10-0.95	0.041
		East	4	48, 40-56	1.52, 0.80-2.87	0.191
		West	12	19, 13-27	0.58, 0.37-0.91	0.020
		South	8	23, 15-32	0.69, 0.42-1.12	0.128
Relative	32	<i>Region</i>				
		North India	10	28, 25-32	Reference	
		Central	1	11, 6-17	0.38, 0.10-1.45	0.149
		East	3	5, 2-10	0.17, 0.07-0.39	<0.0001
		West	10	19, 15-24	0.63, 0.35-1.12	0.112
		South	8	11, 6-16	0.31, 0.17-0.56	<0.0001
Teacher	25	<i>Recruitment</i>				
		Community	7	19, 11-30	Reference	
		School	18	9, 5-15	0.40, 0.17-0.94	0.037
Media	17	<i>Region</i>				
		North India	6	25, 13-38	Reference	
		Central	0	-	-	
		East	2	12, 1-34	0.47, 0.15-1.50	0.185
		West	5	4, 2-7	0.18, 0.08-0.43	0.001
		South	4	21, 11-33	0.89, 0.36-2.22	0.790
Health worker	4				No significant variables	
Knowledge on menstruation and perception						
Uterus is source of bleeding	43				No significant variables	
Menstruation is a normal phenomena	54	<i>Recruitment</i>				
		Community	10	42, 22-64	Reference	
		School	40	61, 52-69	1.16, 0.73-1.84	0.528
		Other	4	28, 6-58	0.54, 0.27-1.10	0.089
		<i>Adolescents</i>				
		Completely	51	57, 49-65	2.83, 1.29-6.23	0.010
		Partly	3	21, 2-52	Reference	
		<i>Year of study</i>			1.04, 1.00-1.08	0.046
Resources on menstruation among participants						
Mother	41				No significant variables	
Friend	35				No significant variables	
Relative	31	<i>Quality score</i>	31		1.44, 1.15-1.80	0.003
		<i>Adolescents</i>				
		Completely	28	15, 11-20	5.08, 1.82-14.14	0.003
		Partly	3	7, 0-25	Reference	
Teacher	23	<i>Year of study</i>			1.23, 1.09-1.39	0.002
Media	24	<i>Quality score</i>			1.75, 1.16-2.63	0.022
		<i>Setting</i>				
		Rural	11	7, 3-11	Reference	
		Urban	10	14, 7-22	2.42, 0.97-6.07	0.038
		Slum	1	33, 30-37	0.65, 0.05-8.92	0.610
		Combination	2	8, 0-30	2.61, 0.48-14.06	0.248
		<i>Data collection</i>				
		Self-administered	12	7, 3-11	0.34, 0.14-0.84	0.022
		Interview	12	15, 8-24	Reference	
Health worker	8				No significant variables	

Abbreviations: CI: confidence interval

*Only factors with a p-value < 0.1 for one or more levels in multivariate analysis are presented in this table.

Table S2-4: Subgroup analysis and meta-regression of factors that may affect the use of commercial pads among adolescents, studies in India published between 2000 and 2015

Univariate analysis									
Covariate	Type of covariate	# *	Pooled Prevalence %	I², %	Odds ratio 95% CI for meta-regression	p-value by level	τ²	Variance explained (%)	p-value overall
No covariates		104	46, 39-52	99.6			1.021		
Recruitment of study population	Community	37	35, 27-43	98.7	1.00 Reference		0.973	4.7	0.035
	School	62	52, 44-61	99.3	1.71, 1.14-2.57	0.010			
	Other	5	39, 13-70	99.2	1.21, 0.48-3.09	0.686			
Setting of study	Rural	56	32, 25-38	98.6	1.00		0.879	13.9	0.0005
	Urban	38	67, 57-76	99.3	2.31, 1.56-3.42	<0.001			
	Slum	9	43, 20-67	99.2	1.00, 0.51-1.96	0.996			
	Combination	1	63, 52-73		2.61, 0.39-17.30	0.316			
Last year of study	Continuous	104			1.13, 1.07-1.18	<0.0001	0.850	16.7	<0.0001
	< 2010	26	28, 19-38	98.5	1.00		0.944	7.5	0.003
	≥2010	78	52, 44-59	99.3	1.95, 1.26-3.03	0.003			
Region of study	North	19	43, 25-62	99.6	1.00		1.028	0.0	0.520
	Central	5	26, 12-44	98.7	0.73, 0.26-2.00	0.531			
	East	19	44, 31-57	99.1	1.10, 0.57-2.12	0.772			
	West	29	43, 31-55	98.9	0.94, 0.52-1.71	0.842			
	South	32	54, 43-65	99.2	1.38, 0.77-2.47	0.278			
Completely or partly adolescents	Completely	94	48, 41-55	99.3	1.49, 0.77-2.91	0.238	1.016	0.4	0.238
	Partly	10	28, 18-39	97.5	1.00				
Self-administered or interview	Self	50	51, 42-59	99.0	1.41, 0.95-2.08	0.085	1.001	1.9	0.085
	Interviewed	54	41, 32-51	99.4	1.00				
Quality score	Continuous				0.86, 0.76-0.98	0.027	0.982	3.8	0.027
	>4	26	30, 20-40	99.3	0.52, 0.33-0.80	0.003	0.946	7.3	0.003
	≤4	78	51, 44-59	99.1	1.00				
Study is a random sample	Yes	36	39, 30-48	99.2	0.74, 0.49-1.11	0.142	1.009	1.1	0.142
	No	68	49, 40-58	99.3	1.00				
Multivariate analysis									
Setting of study	Rural	56			1.00				
	Urban	38			2.14, 1.50-3.04	<0.0001			
	Slum	9			0.92, 0.51-1.66	0.778			
	Combination	1			3.95, 0.74-20.93	0.106			
Year of study	Continuous	104			1.12, 1.07-1.17	<0.0001			
Quality score	>4	26			0.64, 0.43-0.94	0.024			
	≤4	78			1.00				

*One study (Anand et al 2015) excluded; this study is from a large national sample and inclusion distorted the meta-analyses¹

Table S2-5: Summary of results of subgroup analysis and meta-regression of other outcomes for table 3

Outcome	Total #	Subgroup analysis for variables significant in meta-regression			Multivariate meta-regression (if applicable)*		
Absorbents used		Variable	#	PP, %, 95% CI	Odds ratio, 95% CI	P	
Cloths	101	<i>Setting</i>					
		Rural	55	63, 56-70	Reference		
		Urban	35	27, 18-37	0.39, 0.25-0.60	<0.0001	
		Slum	8	61, 35-83	0.74, 0.34-1.60	0.437	
		Combination	3	71, 17-100	0.80, 0.26-2.46	0.689	
		<i>Recruitment</i>					
		Community	38	68, 59-76	Reference		
Pads and cloths	42	School	57	37, 29-45	0.56, 0.36-0.85	0.007	
		Other	6	63, 36-86	0.94, 0.39-2.28	0.895	
		<i>Year of study</i>					
Cottons/home-made disposable items	12	<i>Year of study</i>	12		1.17, 1.05-1.31	0.009	
Disposal of absorbent							
Routine waste/dustbin	44	<i>Setting</i>					
		Rural	25	28, 19-38	Reference		
		Urban	16	70, 60-79	3.14, 1.84-5.36	<0.0001	
"Throw away"	34	Slum	3	51, 47-55	2.50, 0.90-6.95	0.078	
		<i>Recruitment</i>					
		Community	14	35, 24-46	Reference		
		School	17	16, 8-26	0.32, 0.17-0.60	0.001	
		Other	2	13, 10-16	0.26, 0.07-1.03	0.055	
		<i>Random sample</i>					
Burning	31	Yes	15	17, 9-28	0.35, 0.19-0.67	0.002	
		No	19	28, 20-37	Reference		
Burying	24	<i>Quality score</i>					
		>4	10	3, 0-7	0.10, 0.03-0.38	0.001	
In toilet	17	≤4	21	28, 15-43	Reference		
		<i>Recruitment</i>					
		Community	10	46, 34-57	Reference		
		School	13	14, 9-20	0.39, 0.22-0.70	0.003	
		Other	1	4, 2-6	0.06, 0.02-0.21	<0.0001	
		<i>Quality score</i>					
Hygiene	39	<i>Year of study</i>					
		1.19, 1.08-1.31	0.002				
		1.18, 1.01-1.38	0.041				
		<i>Region</i>					
		North India	3	2, 0-7	Reference		
		Central	0				
		East	3	3, 1-6	2.81, 0.55-14.43	0.193	
		West	4	5, 0-13	4.82, 0.94-24.75	0.058	
		South	7	17, 6-31	7.44, 1.94-28.58	0.007	
		<i>Recruitment</i>					
Community	2	28, 0-90	Reference				
School	14	7, 4-11	0.26, 0.06-1.21	0.080			
Other	1	0, 0-2	0.02, 0.00-0.29	0.008			
Daily bath	39	<i>Setting</i>					
		Rural	24	86, 76-93	Reference		
		Urban	12	92, 86-97	1.34, 0.80-2.26	0.261	
		Slum	1	15, 13-18	0.19, 0.05-0.81	0.026	
		Combined	2	33, 0-100	0.22, 0.08-0.61	0.005	
		<i>Region</i>					
		North India	8	67, 35-92	Reference		
		Central	4	93, 91-95	2.33, 0.98-5.52	0.055	
		East	10	84, 61-98	1.95, 0.99-3.83	0.052	
		West	4	94, 79-100	1.69, 0.72-3.97	0.220	
		South	13	87, 76-95	2.04, 1.11-3.75	0.023	

*Only factors with a p-value < 0.1 for any level are presented in this table

Table S2-6: Quotes and data related to choice of cloths or pads in India, from studies on menstrual hygiene management among adolescent girls, published between 2000 and 2015

Publication (1 st author and year)	State	Setting	Descriptions or data																								
Amirtha 2013 ²	Pondicherry	Urban	“When asked about the best absorbent material that can be used during menstruation, 88% girls said sanitary napkins.” The major felt needs of the girls were clean toilets (39.5%) and provision of low-cost sanitary napkins in schools (22.5%)																								
Baridalyne 2004 ³	New Delhi	Urban	Use of sanitary napkins associated with literacy of the mother (46/76 or 60.5% among daughters of literate mothers vs. 26/178 or 14.6% among daughters of illiterate mothers, risk ratio 4.1, 95% CI 2.8-6.2, p<0.001) Reasons not using pads: High costs 163/183 (89.1)																								
Bathija 2013 ⁴	Karnataka	Urban	Reasons not using pads (n=79) -Feel comfortable with cloth 80% -Not willing to use 1% -Costly 18% -Out of tradition 1%																								
Boratne 2014 ⁵	Pondicherry	Urban and rural	“Most of the girls agreed to usefulness of sanitary pads during menses as it absorbs heavy flow, but few are concerned about its chemical smell/cost/non-availability at local shops and find difficulties to pay for transport. They also expect to get training which will make them understand the proper method of using sanitary pads.”																								
Borker 2014 ⁶	Kerala	Rural	“Further probing questions indicated that they were not aware regarding the method of its disposal (napkin).” Ideal absorbent: napkin: 90/217 (41.5%), cloth 127/217 (58.5%) Main reason not using napkin: Economic reason: 40/114 (35%) Not aware of it: 33/114 (29%) Don't like it: 33/114 (29%)																								
Datta 2012 ⁷	West Bengal	Urban and rural	Pros and contras of napkin <table border="1"> <thead> <tr> <th></th> <th>Urban, % (n=68)</th> <th>Rural, % (n=87)</th> </tr> </thead> <tbody> <tr> <td>Ideal absorbent</td> <td>95.6</td> <td>92.0</td> </tr> <tr> <td>Comfortable</td> <td>55.9</td> <td>36.8</td> </tr> <tr> <td>Adequate absorption</td> <td>29.4</td> <td>58.6</td> </tr> <tr> <td>Does not stain clothes</td> <td>36.8</td> <td>16.1</td> </tr> <tr> <td>Does not itch</td> <td>10.3</td> <td>3.4</td> </tr> <tr> <td>Expensive</td> <td>41.2</td> <td>49.4</td> </tr> <tr> <td>Not everywhere available</td> <td>26.5</td> <td>8.0</td> </tr> </tbody> </table>		Urban, % (n=68)	Rural, % (n=87)	Ideal absorbent	95.6	92.0	Comfortable	55.9	36.8	Adequate absorption	29.4	58.6	Does not stain clothes	36.8	16.1	Does not itch	10.3	3.4	Expensive	41.2	49.4	Not everywhere available	26.5	8.0
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Not everywhere available	26.5	8.0																									
Dube 2012 ⁸	Rajasthan	Urban and rural	“The main reason for using home-made napkins was the inability to buy costly readymade napkins.”																								
Gupta 2001 ⁹	Rajasthan	Urban	“All four fathers, with whom we succeeded in having a dialogue, thought that their role was limited to paying for the sanitary napkins used by their daughters. One of them even suggested that some research should be done on finding cheaper substitutes for these readymade but expensive sanitary napkins.”																								
Jain 2012 ¹⁰	Rajasthan	Rural	“Majority of respondent (87%) revealed that they can't afford sanitary napkin.” (N=161)																								
Jothy 2012 ¹¹	Tamil Nadu	Rural	Reasons not using pads (n=226) -Don't know 10.2% -Not easily available 33.6% -Difficulty of disposal 25.7% -High costs 47.3% -Not knowing about it 54.9%																								
Kamath 2013 ¹²	Karnataka	Urban and rural	Reasons for not using pads (denominators not reported) <table border="1"> <thead> <tr> <th></th> <th>Urban, %</th> <th>Rural, %</th> </tr> </thead> <tbody> <tr> <td>Difficult to dispose</td> <td>55.6</td> <td>55.6</td> </tr> <tr> <td>High costs of pads</td> <td>0</td> <td>30.8</td> </tr> <tr> <td>No knowledge about it</td> <td>11.1</td> <td>23.1</td> </tr> </tbody> </table>		Urban, %	Rural, %	Difficult to dispose	55.6	55.6	High costs of pads	0	30.8	No knowledge about it	11.1	23.1												
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High costs of pads	0	30.8																									
No knowledge about it	11.1	23.1																									
Kumar 2011 ¹³	Jharkand	Urban	“The girls from rich families reported that they use sanitary napkins whereas the girls from urban slum do not use sanitary napkins because of monetary problems. They also reported having less access to private bathrooms.”																								
Leuva 2014 ¹⁴	Gujarat	Urban and rural	98/256 used pads 147/256 preferred pads Reasons not using pads: Lack of knowledge: 30.3% High costs: 30.9% Unavailability and shyness (no data)																								
Misra 2013 ¹⁵	Haryana	Rural	Reasons for using pads, % (n=287) Safe and easy 77.0 Get stains with cloths 13.6 Cannot get cloth at home 3.1 Absorbs well 2.8 Easily accessible 2.1 Used to it 1.4 Reasons for using cloths, % (n=582) Easily available 49.7 Comfortable 23.7 Cheaper 9.8 Can't get napkins 7.9 Don't like napkins 2.9 Can be reused 2.6 Absorb well 1.5 Don't know napkins 1.9																								
Nielsen 2012 Jaunpur ¹⁶	Uttar Pradesh	Rural	Reason for cloth as menstrual absorbent, % (n=513) <table border="1"> <tbody> <tr> <td>Economical</td> <td>63.2</td> </tr> <tr> <td>Easily available</td> <td>58.3</td> </tr> <tr> <td>Can be reused</td> <td>9.0</td> </tr> <tr> <td>Easy to wash and dispose</td> <td>6.2</td> </tr> <tr> <td>Lack of awareness of napkins</td> <td>1.0</td> </tr> <tr> <td>Tradition of using cloth</td> <td>6.6</td> </tr> </tbody> </table>	Economical	63.2	Easily available	58.3	Can be reused	9.0	Easy to wash and dispose	6.2	Lack of awareness of napkins	1.0	Tradition of using cloth	6.6												
Economical	63.2																										
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Lack of awareness of napkins	1.0																										
Tradition of using cloth	6.6																										

Nielsen 2012 Mirzapur ¹⁷	Uttar Pradesh	Rural	Cloth more comfortable	30.8			
			Reason for cloth as menstrual absorbent, % (n=513)				
			Economical	61.0			
			Easily available	66.5			
			Can be reused	19.3			
			Easy to wash and dispose	4.9			
			Lack of awareness of napkins	0.6			
			Tradition of using cloth	8.2			
Nielsen 2012 Sonebhadra ¹⁸	Uttar Pradesh	Rural	Cloth more comfortable	22.8			
			Reason for cloth as menstrual absorbent, % (n=547)				
			Economical	69.5			
			Easily available	83.7			
			Can be reused	65.3			
			Easy to wash and dispose	4.8			
			Lack of awareness of napkins	0.2			
			Tradition of using cloth	3.7			
Nielsen 2013 East-Singhbhum ¹⁹	Jharkhand	Rural	Cloth more comfortable	6.4			
			Reason for cloth as menstrual absorbent, % (n=436)				
			Economical	65.4			
			Easily available	67.4			
			Can be reused	86.7			
			Easy to wash and dispose	10.3			
			Lack of awareness of napkins	0.7			
			Tradition of using cloth	4.8			
Nielsen 2013 Gumla ²⁰	Jharkhand	Rural	Cloth more comfortable	9.2			
			Reason for cloth as menstrual absorbent, % (n=379)				
			Economical	48.8			
			Easily available	62.8			
			Can be reused	89.2			
			Easy to wash and dispose	6.9			
			Lack of awareness of napkins	0.5			
			Tradition of using cloth	5.3			
Nielsen 2013 Nalanda ²¹	Bihar	Rural	Cloth more comfortable	7.3			
			Reason for cloth as menstrual absorbent, % (n=532)				
			Economical	82.1			
			Easily available	65.4			
			Can be reused	2.8			
			Easy to wash and dispose	1.5			
			Lack of awareness of napkins	0.9			
			Tradition of using cloth	18.4			
Nielsen 2013 Vaishali ²²	Bihar	Rural	Cloth more comfortable	0.2			
			Reason for cloth as menstrual absorbent, % (n=322)				
			Economical	75.8			
			Easily available	77.3			
			Can be reused	31.4			
			Easy to wash and dispose	3.4			
			Lack of awareness of napkins	0.3			
			Tradition of using cloth	4.7			
Prerana 2015 ²³ Rana 2015 ²⁴	Maharashtra	Rural	Reason for not using pads (n=54): expensive 21 (38.9%)				
	Gujarat	Rural	"85 (34.8%) had problem of ill-fitting, itching, rash and staining with the use of cloth. 7 (4.5%) users of sanitary pad had problem of itching and rash."				
Shah 2013 ²⁵	Gujarat	Rural	"During menstrual periods we can't play at school, we just sit in the classroom, but we will be able to play now with sanitary pads." (They were afraid that the old menstrual cloths might fall out while they were playing.) "We don't like sanitary pads as they spoil our clothes." "Sanitary pads need to be changed more frequently."	"After repeated use (3-4 menstrual cycles), old cloths become stiff and we get abrasions on the skin of our inner thighs." "Stains of menstrual blood are visible on old cloths and it smells, we feel dirty and ashamed."	Reasons for the preference for Falalin: -low cost -easy availability -good absorption capacity -No stains visible: can be dried in visible place		
Singh 2006 IJCM ²⁶	Punjab	Rural	"girls did not use any underwear in routine before attaining menarche". "Majority of their respondents (70-76%) did not even use any underwear in routine life."				
Sudeshna 2012 ²⁷	West Bengal	Rural	"...reasons for not using sanitary towels were high cost of the sanitary pads, embarrassment to buy them and lack of knowledge of method of using them." "...it was traditional for them to use cloth as their mothers have also been using that."				
Verma 2013 ²⁸	Uttar Pradesh	Urban	Willing to use pads: 111/120 (92.5)	Reasons not using pads: High costs 45/63 (71.4) Unavailability 4/63 (6.3)	Shyness: 5/63 (7.9) Not comfortable 9/63 (14.3)		
Vidya 2013 ²⁹	Karnataka	Rural	64.7% of the study population felt that sanitary napkin is the ideal				

absorbent, but in practice only 42.8% were using it and while 35.2% of the study population felt that cloth is the ideal material, in practice 32.7% were using it

Table S2-7: Restrictions and beliefs with regards to menstruation in India, from studies on menstrual hygiene management among adolescent girls, published between 2000 and 2015

Publication (1 st author and year)	State	Setting	Description of restriction or belief	Frequency (%)
Anuradha 2000 ³⁰	Kerala	Rural	Decreased urination: "Do not want to change the cloth in between", "do not want to use the same cloth after urination", "do not want to get noticed", "feels dirty to wear same material after urination" "Non-availability of bathroom"	162/360 (45.0)
Arora 2013 ³¹	Haryana	Rural	Menstruation can be influenced by hot or cold food	196/200 (98.0)
Arunmozhi 2013 ³²	Tamil Nadu	Urban	Restriction to use toilet or bathroom at home	56/377 (14.9)
Boratne 2014 ⁵	Pondicherry	Urban & rural	Not allowed to touch anyone before taking bath during menses. To sleep on ground alone without pillow. Not to use flowers on hair. "They are strictly asked not to meet boys to avoid pimples on face. They are supposed to eat all which is served in plate and not to give it to dog thinking it can cause pain in abdomen" "Girls are compelled to take bath early in morning and clean bathroom thereafter. They are also supposed to wash their clothes, bed sheets and mat after getting up." "Certain food items (mango, papaya, sweets, non-vegetarian food) cause increase in menstrual flow or result in foul smelling discharge."	No data
Bhudhagaonkar 2014 ³³	Maharashtra	Rural	Use separate utensils and keep them separate	10/100 (10.0)
Dasgupta 2008 ³⁴	West Bengal	Rural	Not eating food such as sour foods, banana, radish and palm	68/160 (42.5)
Deo 2005 ³⁵	Maharashtra	Urban & rural	Restrictions on type of clothing	46/168 (27.4)
Deo 2005 ³⁵	Maharashtra	Urban & rural	Avoiding interaction with boys	42/168 (25.0)
Dhingra 2009 ³⁶	Jammu & Kashmir	Urban & rural	Not to look in mirror during period	200/200 (100.0)
Dhingra 2009 ³⁶	Jammu & Kashmir	Urban & rural	Stay away from flowing water (e.g. river)	182/200 (91.0)
Gupta 2001 ⁹	Rajasthan	Urban	"In some families, it was the norm to observe isolation for three days. A woman could resume her normal routine only after a bath on the fourth day. These families also had different euphemisms for menses such as "the crow or the lizard has touched her", "she is on rest", "she is away."	No data
Jain 2012 ¹⁰	Rajasthan	Urban	Don't take water from pot	90/161 (55.9)
Kavitha 2012 ³⁷	Tamil Nadu	Urban	Don't sit on threshold	10/144 (6.9)
Khanna 2005 ³⁸	Rajasthan	Urban & rural	Don't wash hair	11/730 (1.5)
Kumar 2011 ¹³	Jharkhand	Urban	"Girls from slum areas believed that if a cow consumes the menstrual cloth or the sanitary napkin, the girl who used it can never become pregnant." "It is believed among most of the girls in the slum areas that if a sanitary napkin is burnt after disposing then the girl who used it can never become pregnant."	No data
Kumari 2014 ³⁹	Jammu & Kashmir	Urban & rural	Practices of other people to clean up themselves after touching a menstruating girl: 1) Spray water 2) Have bath 3) Touch cow	1) Urban: 9/30 (30.0) Rural: 10/30 (33.3) 2) Urban: 13/30 (43.3) Rural: 0/30 (0.0) 3) Urban: 0/30 (0.0) Rural: 2/30 (6.7)
Manhas 2015 ⁴⁰	Jammu & Kashmir	Urban	..sprinkle <i>tulsi</i> water or cow urine in the house after they bathe to "make it pure again" Avoid eating citrus food Avoid cold food Avoid spicy food	89% 8% 3%
Minhas 2014 ⁴¹	Maharashtra	Urban & rural	Anybody coming in contact with menstruating girl must clean up by having bath or spray water on themselves	Urban: 13/30 (43.3) Rural: 10/30 (33.3)
Minhas 2014 ⁴¹	Maharashtra	Urban & rural	Not touch cow	2/30 (3.3)
Minhas 2014 ⁴¹	Maharashtra	Urban & rural	Not eating rice, curd or cucumber	37/60 (61.7)
Mudey 2010 ⁴²	Maharashtra	Rural	Keeping fast	8/300 (2.7)
Mudey 2010 ⁴²	Maharashtra	Rural	Avoiding regular bath	19/300 (6.3)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Should not see birds	68/619 (11.0)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Should not sit on threshold	433/619 (70.0)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Dog should not eat leftover food	450/619 (72.7)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Should not see men before bathing	195/619 (31.5)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Mother should not be the first to see the menarche of the girl	302/619 (48.8)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Widow should not be the first to see the menarche	79/619 (12.8)

of the girl

Narayan 2001 ⁴³	Pondicherry	Urban & rural	Lizard should not eat the bloody tissues	221/619 (35.7)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Should not touch plants	429/619 (69.3)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Should not keep flowers	364/619 (58.8)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Should not touch infants	239/619 (38.6)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Should take neem twig when going out	360/619 (58.2)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Should not go out at noon	338/619 (54.6)
Narayan 2001 ⁴³	Pondicherry	Urban & rural	Should take neem and piece of iron when going to school	211/619 (34.1)
Nemade 2009 ⁴⁴	Maharashtra	Urban	Menstruation can be influenced by hot or cold food	173/217 (79.7)
Parameaswari 2014 ⁴⁵	Tamil Nadu	Urban	Should not touch plants	422/425 (99.3)
Parameaswari 2014 ⁴⁵	Tamil Nadu	Urban	Should not attend exams	23/425 (5.4)
Puri 2006 ⁴⁶	Punjab	Urban & rural	Should not wear new clothes	Not reported
Puri 2006 ⁴⁶	Punjab	Urban & rural	Should not look in the mirror	Not reported
Shanbagh 2012 ⁴⁷	Karnataka	Rural	Consume less food during menstruation	191/329 (58.1)
Sudeshna 2012 ²⁷	West Bengal	Rural	Not picking flowers	128/190 (67.4)
Singh 2006 ⁴⁸	Uttar Pradesh	Urban & Rural	Dangerous to go swimming and running during period	76/504 (15.1)
Singh 2013 ⁴⁹	Uttarakhand	Rural	Menstruation can be influenced by hot or cold food	169/200 (84.5)
Thakre 2011 ⁵⁰	Maharashtra	Urban & rural	Should not sit on threshold	17/387 (4.4)
Thakur 2014 ⁵¹	Maharashtra	Urban	Should wash hair on the third or fourth day of the period	Not reported
Thakur 2014 ⁵¹	Maharashtra	Urban	“It was revealed that women cannot discuss openly at home about menstrual issues and they are considered unclean and untouchable during their menstrual periods. They are not allowed to carry out religious functions and not supposed to participate in the cooking during these periods.”	Not reported
Unni 2010 ⁵²	Kerala	Urban	Unhealthy for a girl to swim or bath during period	181/589 (30.7)
Venkatash 2011 ⁵³	Karnataka	Slum and rural	“A few girls mentioned the belief prevalent in the area that in the event of a crow’s shadow falling on that piece of sanitary cloth when drying in the open, it was believed that it would bring misfortune to the family.”	Not reported

Figure S2-1: Pooled prevalence of some beliefs with regard to menstruation in India, from studies on menstrual hygiene management among adolescent girls, published between 2000 and 2015

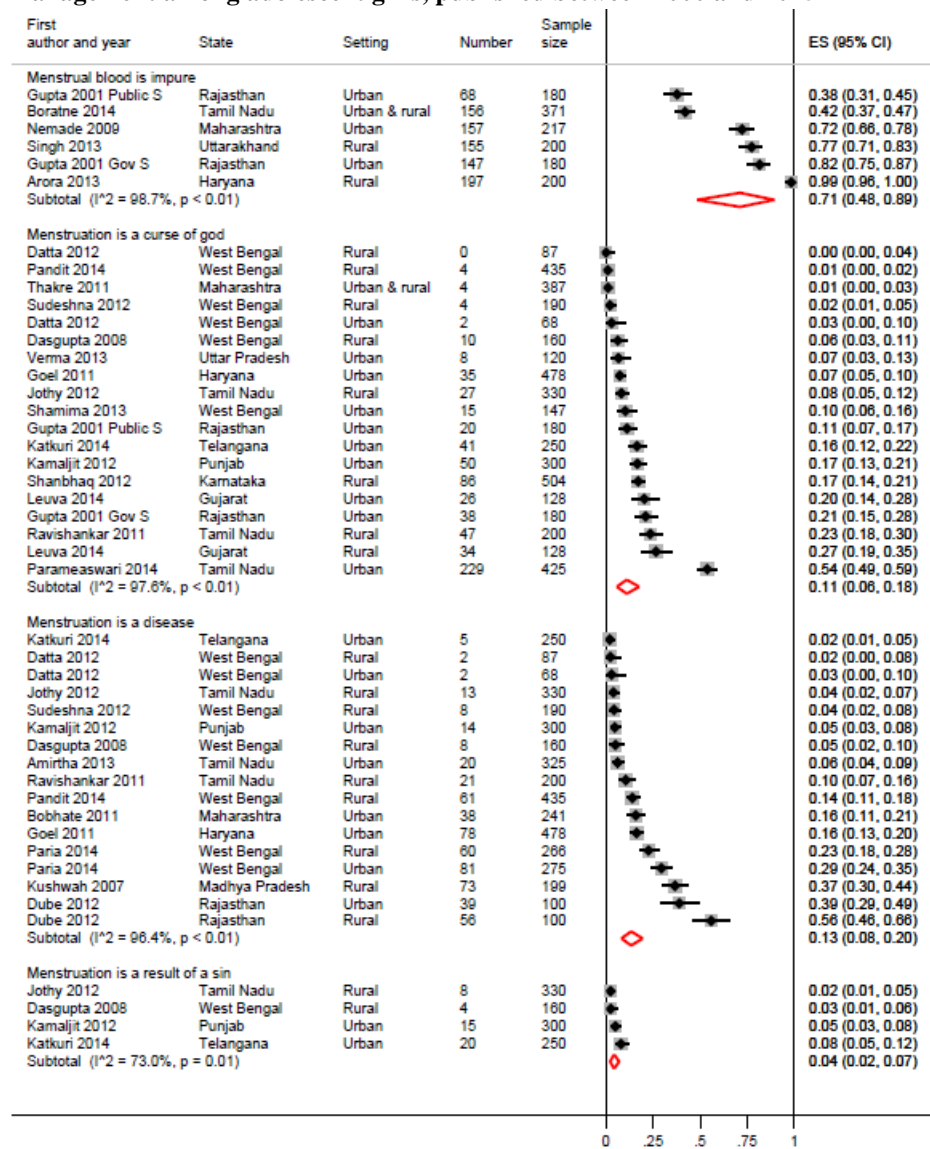


Table S2-8: Quotes and data related to menstruation and school absenteeism or changing absorbents in school in India, from studies on menstrual hygiene management among adolescent girls, published between 2000 and 2015

Publication (1 st author and year)	State	Setting	Descriptions, quotes, or data
Amirtha 2013 ²	Pondicherry	Urban	Both schools of surveys had separate toilets for girls, but no facility to provide free or low cost pads to students. Menstruation led to inability to concentrate in class. Staining of dress frequently encountered. "The most common reason cited (for school absenteeism during period) was abdominal pain." "Teachers should not scold us for not carrying pads." No covered bins for disposal: 81/325 (25.0) Bins present in toilets not cleared regularly: 117/325 (36.0) Students not equipped for sudden period: 202/325 (62.2)
Anuradha 2000 ³⁰	Kerala	Rural	"When asked about facilities for changing napkins, all the subjects agreed that they had facilities at home while 38.5 percent pointed out that there is no facility for changing a napkin at the work place (school/ college/office). Many school/college students have pointed out that the maintenance of school bathrooms were poor and that the water supply to the school/college toilet was inadequate."
Arunmozhi 2013 ³²	Tamil Nadu	Urban	"The most common reason cited for taking leave was excessive pain in the back and abdomen" (reported among 78/115 or 67.8% girls with absenteeism during period). Toilet available at school: 346/371 (93.3) Cleanliness of school toilet: 250/371 (67.4) Water availability: 307/373 (82.3) Disposal availability: 222/370 (59.5) Free pads given in school: 337/379 (88.9)
Bodat 2013 ⁵⁴	Maharashtra	Rural	269/622 absent during period. Mean number of absent days 1.2, sd 0.7, n=269; 78.1% one day absent. Absenteeism during period significantly associated with type of absorbent, dysmenorrhoea, and socio-economic status. Reasons for absenteeism or not using toilet facility during menstruation: Same toilet entrance for boys and girls: 71/283 (25.1) Water supply outside bathroom: 66/283 (23.3) Dirty toilets: 67/283 (23.7) No need to change 38/283 (13.5) No dustbin: 12/283 (4.2) No door locking system: 26/283 (9.2) Lack of privacy: 3/283 (1.1)
Gupta 2001 ⁹	Rajasthan	Urban	"At the same time, a few girls resented the fact that their teachers had instructed them to stay at home during periods." "They also complained that while some teachers were sympathetic and kind, many were very insensitive towards their physical and mental state during those days, and would openly reprimand them in the class for not being careful and sufficiently prepared"
Jothy 2012 ¹¹	Tamil Nadu	Rural	"... many girls shared while interact with them that though physically present in the school they performed poorly in terms of concentration and attention. This was particularly due to constant worry that boys might figure out about their status by their movements and facial expressions." "Another major worry expressed by the girls was having their menstruation coinciding with exams as they would not get adequate time and opportunity to clean and change timely." "...most of the toilets in schools are in unusable conditions i.e. without water supply and missing of basic lock system and surrounded by bushes." Reasons school absenteeism during menstruation (191/330 or 58%): Lack of water supply for cleaning: 170/191 (89) Pain/discomfort: 140/191 (73.3) Shame: 102/191 (53.4) Lack of privacy for cleaning/washing: 95/191 (49.7) Socio-cultural beliefs: 60/191 (31.4) Fear of menstrual accident/leakage: 49/191 (25.6)
Kamath 2013 ¹²	Karnataka	Urban and rural	Reasons not changing pads in schools Feeling uncomfortable in school facility: 399/550 (72.6) Lack of water and disposal facilities in rural schools: 68/280 (24.2) Unhygienic conditions for changing absorbent in rural school: 17/280 (6.2)
Nielsen 2012 Jaunpur ¹⁶	Uttar Pradesh	Rural	Reasons missing school (n=345) Pain or physical discomfort 87.2% No place to change or dispose 12.5% Fear or staining the clothes 45.2% Shame/embarrassment 5.2% 88.4% misses 1-2 days Toilets at school: 200/217 (92.2%) Reasons not using toilet at school (n=200): Door remains locked: 4/200 (2%) No water/soap in toilet to wash: 58/200 (29%) No place to dispose absorbent: 24/200 (12%) Door cannot be locked: 16/200 (8%)
Nielsen 2012 Mirzapur ¹⁷	Uttar Pradesh	Rural	Reasons missing school (n=258) Pain or physical discomfort 83.3% No place to change or dispose 8.1% Fear or staining the clothes 41.1% Shame/embarrassment 3.5% 89.5% misses 1-2 days Toilets at school: 381/433 (88.0%) Reasons not using toilet at school (n=169): No soap in toilet to wash: 7% No place to dispose absorbent: 17%
Nielsen 2012 Sonebhadra ¹⁸	Uttar Pradesh	Rural	Reasons missing school (n=329) Pain or physical discomfort 83.3% No place to change or dispose 5.2% Fear or staining the clothes 24.3% Shame/embarrassment 1.8% 94.5% misses 1-2 days Toilets at school: 349/423 (82.5%) Reasons not using toilet at school (n=135): No water in toilets: 13% No place to dispose absorbent: 9%
Nielsen 2013 East-Singhbhum ¹⁹	Jharkhand	Rural	Reasons missing school (n=200) Pain or physical discomfort 79.5% No place to change or dispose 9.0% Fear or staining the clothes 37.5% Shame/embarrassment 5.5% 92.5% misses 1-2 days Toilets at school: 335/378 (88.6%) Reasons not using toilet at school (n=171): Toilets remains locked: 3.0% No water in toilets: 21.7% No soap: 21.6% No place to dispose absorbent: 18.0% Door cannot be latched: 1.7%
Nielsen 2013 Gumla ²⁰	Jharkhand	Rural	Reasons missing school (n=158) Pain or physical discomfort 67.1% No place to change or dispose 14.6% Toilets at school: 297/424 (70.0%) Reasons not using toilet at school (n=153): Toilets remains locked: 7.8%

			Fear or staining the clothes 38.6% Shame/embarrassment 22.2% 93.0% misses 1-2 days	No water in toilets: 38.0% No soap: 26.8% No place to dispose absorbent: 20.3% Door cannot be latched: 1.3% It is not safe: 6.5% Place is dirty: 1.3%
Nielsen 2013 Nalanda ²¹	Bihar	Rural	Reasons missing school (n=132) Pain or physical discomfort 87.1% No place to change or dispose 1.5% Fear or staining the clothes 10.6% Shame/embarrassment 8.3% 86.4% misses 1-2 days	Toilets at school: 233/293 (79.5%) Reasons not using toilet at school (n=146): No soap: 25.0% No place to dispose absorbent: 26.0%
Nielsen 2013 Vaishali ²²	Bihar	Rural	Reasons missing school (n=293) Pain or physical discomfort 85.7% No place to change or dispose 3.1% Fear or staining the clothes 20.8% Shame/embarrassment 8.2% 81.2% misses 1-2 days	Toilets at school: 393/428 (91.8%) Reasons not using toilet at school (n=271): Toilet remains locked: 7.0% No water in toilet to wash: 19.0% No soap: 16.0% No place to dispose absorbent: 10.0% Doors cannot be latched from inside: 3%
Reddy 2005 ⁵⁵	Andhra Pradesh	Urban	“However, in most of the private schools where the study was conducted, toilet facilities were highly inadequate. The toilets had no roofs or doors, thereby offering no privacy. Water supply in most toilets was erratic.” They also reported that they were finding it difficult to concentrate on studies during the menstruation.	
Sekhon 2014 ⁵⁶	Jammu & Kashmir	Urban	“The common reasons given were discomfort, easily getting tired and the fear of staining their clothes. Absence from school was more during the first two days of the period that corresponded to heavier flow, in all the cases.”	
Shah 2013 ²⁵	Gujarat	Rural	“Toilets were non-existent at their workplaces (farms) and in most of their schools. If there were toilets in the schools they usually did not have running water.”	
Sudeshna 2012 ²⁷	West Bengal	Rural	“Bathrooms (at school) do not have proper bins to dispose of the pads”. “Bathrooms were in very insanitary condition (cleaned only on weekends) and none of them had any doors”. “Water supply was not continuous (in school toilet)”. “We throw it in the toilet pan but it’s difficult to flush due to lack of constant water supply. Sometimes we also throw it outside the toilet window.”	Lack of proper disposal facility: 143/190 (75.3) Lack of continuous water supply: 127/190 (66.8) Pain and discomfort: 124/190 (65.3) Told by relatives: 89/190 (46.8) Fear of leakage: 45/190 (23.7) Socially withdrawn: 10/190 (5.3)
Thakur 2014 ⁵¹	Maharashtra	Urban	“It’s difficult to carry reusable cloth to school and dispose them off –so we prefer being absent.” “Qualitative methods revealed that most of the girls do not face any problems in school and that the teachers were quite supportive. But in certain public schools where there were no special toilet facilities, the girls had to go home. Some girls mentioned that sanitary pads were available in some schools in case of emergency. The most common worries expressed during qualitative methods were the risk of staining while outside the home, missing the school, the concern about what is happening to the body, and the pain experienced during the menses.”	

Table S2·9: Subgroup analysis and meta-regression of factors that may affect school absence during menstruation among adolescents, studies in India published between 2000 and 2015

Univariate analysis									
Covariate	Type of covariate	No. of Surveys	Pooled Prevalence %	I², %	Odds ratio, 95% CI for meta-regression	p-value by level	τ²	Variance explained (%)	p-value overall
No covariates		64	24, 19-30	98.5			0.976		
Recruitment of study population	Community	19	31, 19-44	98.7	1.00		1.003	0.0	0.871
	School	41	22, 17-28	98.0	0.86, 0.49-1.51	0.605			
	Other	4	18, 11-28	93.9	0.87, 0.29-2.63	0.801			
Setting of study	Rural	33	28, 20-36	98.4	1.00		0.976	0.1	0.397
	Urban	24	23, 16-31	98.4	0.76, 0.45-1.29	0.303			
	Slum	6	12, 9-16	64.6	0.50, 0.21-1.22	0.126			
	Combination	1	26, 23-29		1.25, 0.17-9.34	0.824			
Last year of study	Continuous	64			1.00, 0.93-1.09	0.945	0.992	0.0	0.945
	< 2010	17	25, 16-35	97.7	1.00		0.9913	0.0	0.841
	≥2010	47	24, 18-31	98.7	0.94, 0.54-1.66	0.841			
Region of study	North	9	8, 5-13	91.5	1.00		0.6412	34.3	<0.0001
	Central	5	48, 27-70	98.7	5.96, 2.43-14.64	<0.0001			
	East	14	39, 28-51	97.9	5.11, 2.57-10.19	<0.001			
	West	21	14, 9-20	96.2	1.67, 0.88-3.19	0.114			
	South	15	31, 19-43	98.5	3.62, 1.83-7.15	<0.0001			
Commercial pad	Continuous	53			0.99, 0.98-0.99	0.023	1.025	8.0	0.023
Cloth use	Continuous	48			1.01, 1.00-1.02	0.042	1.005	6.8	0.042
Completely or partly adolescents	Completely	60	24, 18-30	98.6	0.63, 0.23-1.77	0.377	0.979	0.0	0.377
	Partly	4	32, 15-51	94.8	1.00				
Self-administered or interview	Self	30	18, 13-23	97.5	0.61, 0.37-0.99	0.045	0.928	4.9	0.045
	Interviewed	34	31, 22-40	98.8	1.00				
Quality score	Continuous	64			1.28, 1.10-1.48	0.002	0.841	13.8	0.002
	>4	16	41, 30-53	98.7	2.53, 1.50-4.29	0.001	0.824	15.6	0.001
	≤4	48	19, 15-24	97.6	1.00				
Study is a random sample	Yes	18	37, 26-49	98.8	2.19, 1.31-3.68	0.004	0.863	11.6	0.004
	No	46	20, 15-25	97.7	1.00				
Multivariate analysis							0.592	39.3	<0.0001
Region of study	North	9			1.00				
	Central	5			5.58, 2.35-13.25	<0.0001			
	East	14			5.52, 2.83-10.75	<0.0001			
	West	21			1.87, 1.00-3.50	0.050			
	South	15			3.85, 2.00-7.42	<0.0001			
Self-administered or interview	Self	30			0.62, 0.42-0.92	0.019			
	Interviewed	34			1.00				
Absorbents in separate models with significant factors above*									
Commercial pad	Continuous	53			0.99, 0.98-1.00	0.232			
Cloth	Continuous	48			1.00, 0.99-1.01	0.543			

*Models were repeated with the significant factors (region of study and method of data collection) and the absorbents separately, because of the smaller sample size. In these models, the factors significant in multivariate analyses remained significant, whereas commercial pad use or cloth use was not.

Table S2-10: Articles with information on reaction of Indian adolescents to menarche published between 2000 and 2015

Publication (1 st author and year)
Barathalakshmi 2014 ⁵⁷
Bobhate 2011 ⁵⁸
Deo 2005 ³⁵
Dube 2012 ⁸
Gupta 2001 ⁹
Kamath 2013 ¹²
Kumar 2011 ¹³
Mudey 2010 ⁴²
Nemade 2009 ⁴⁴
All Nielsen reports ¹⁶⁻²²
Paria 2014 ⁵⁹
Patle 2014 ⁶⁰
Pokhrel 2014 ⁶¹
Prerana 2015 ²³
Rani 2014 ⁶²
Reddy 2005 ⁵⁵
Shanbhag 2012 ⁴⁷
Tiwari 2006 ⁶³
Udgiri 2010 ⁶⁴
Vidya 2013 ²⁹
Venkatesh 2011 ⁵³
Zaidi 2015 ⁶⁵

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Supplement 3: Forest plots for outcomes examined

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Notes on forest plots

The forest plots are stratified by region. The graphs for awareness before menarche and for commercial pad use were split in two because of their size. The forest plots for resources for knowledge on menstruation are not presented. The overall estimates for outcomes examined are available in Table 2-5 of the main paper.

Figure S3.1A: Awareness among adolescent girls of menarche by region, studies published in India between 2000 and 2015: North, Central and East India

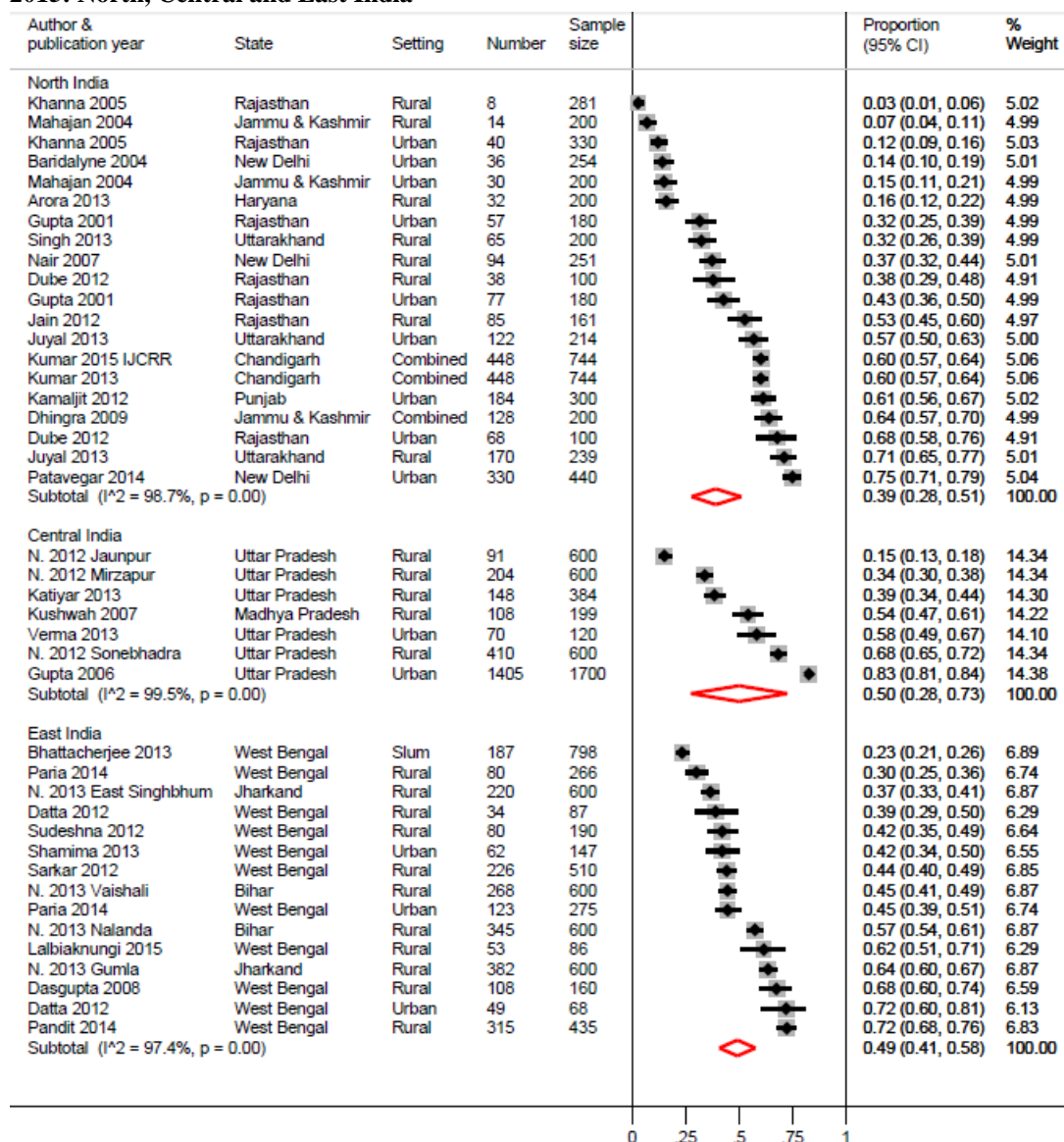


Figure S3.1B: Awareness among adolescent girls of menarche by region, studies published in India between 2000 and 2015, West and South India

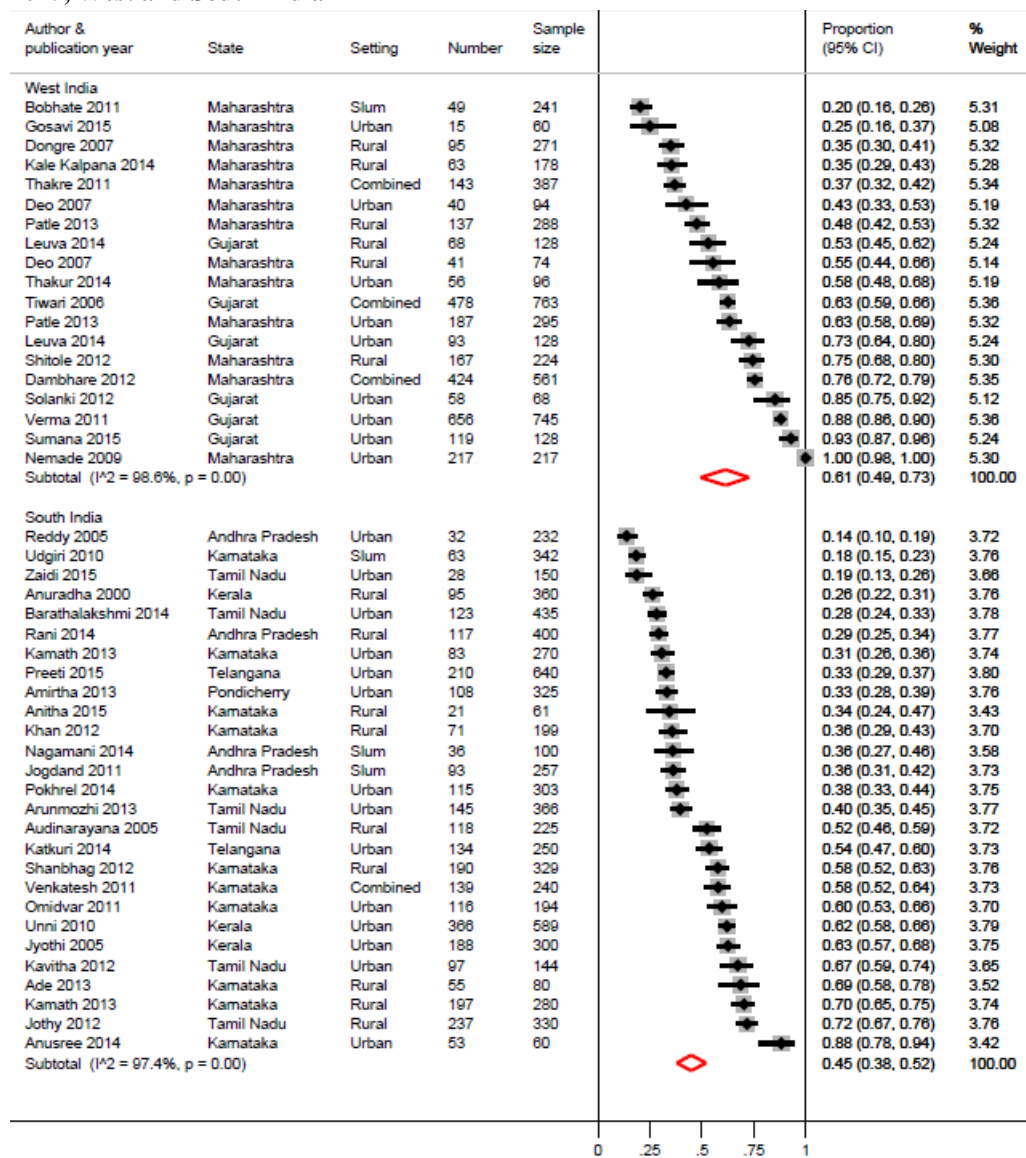


Figure S3.2: Mother as source of awareness of menarche among adolescent girls by region, studies published in India between 2000 and 2015

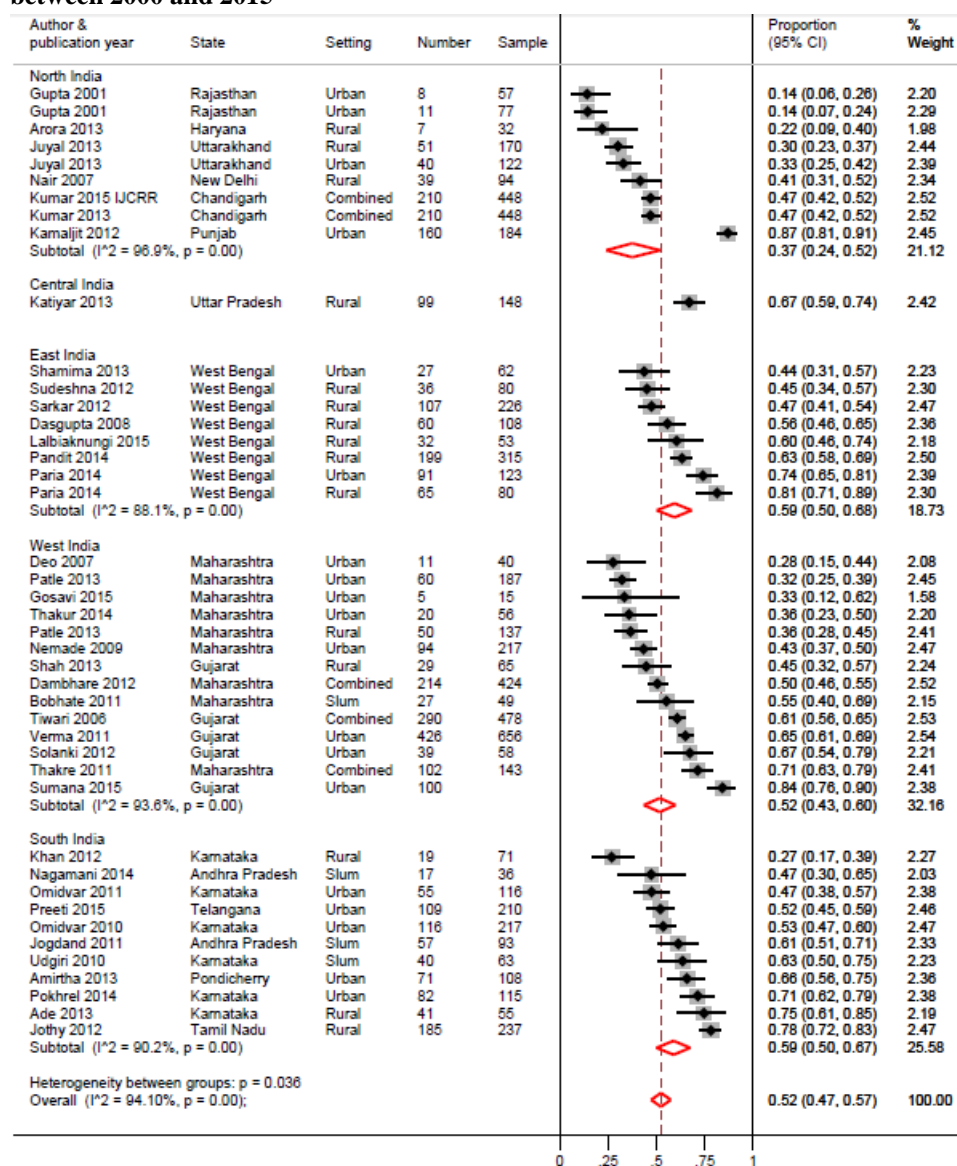


Figure S3.3: Friend as source of awareness of menarche among adolescent girls by region, studies published in India between 2000 and 2015

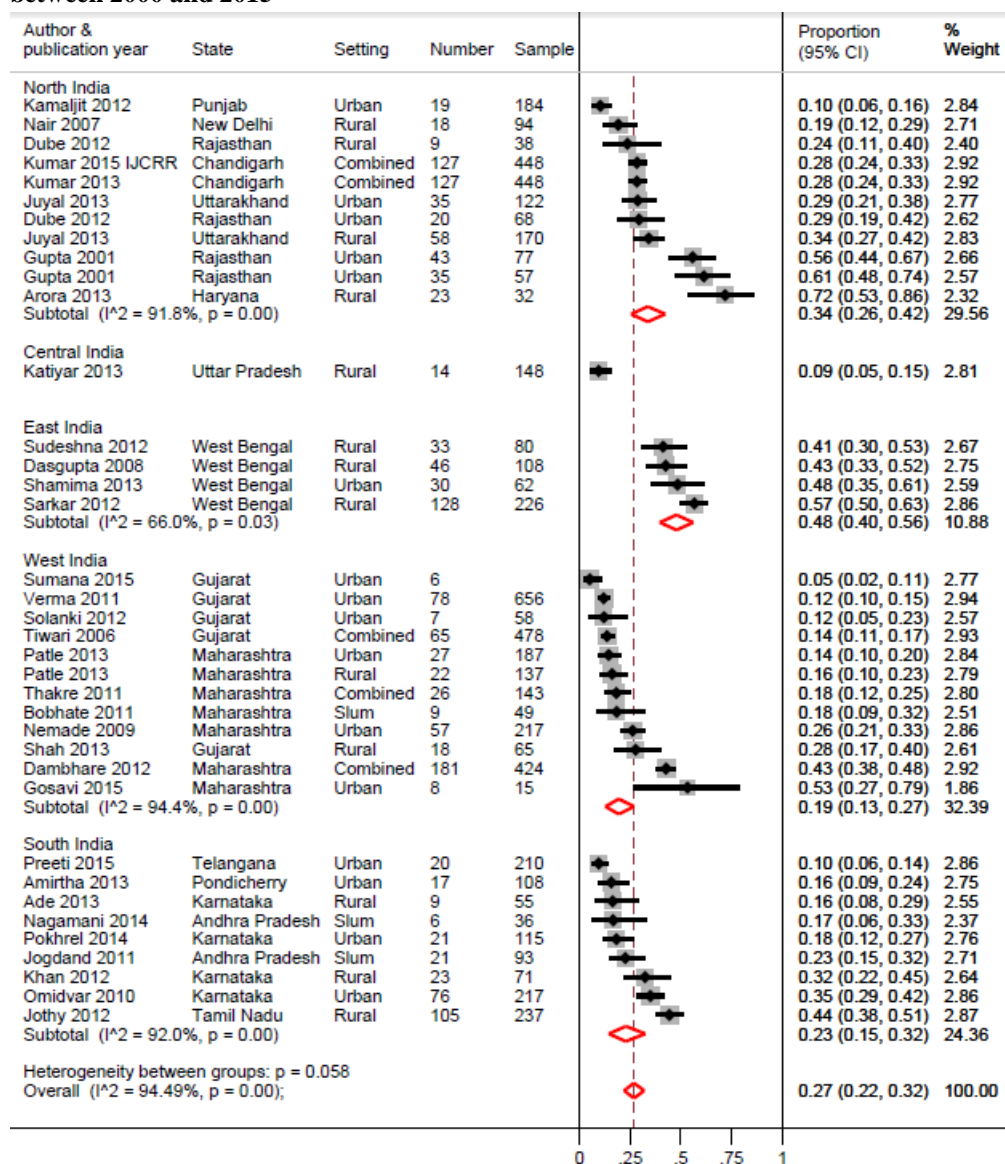


Figure S3.4: Relatives as source of awareness of menarche among adolescent girls by region, studies published in India between 2000 and 2015

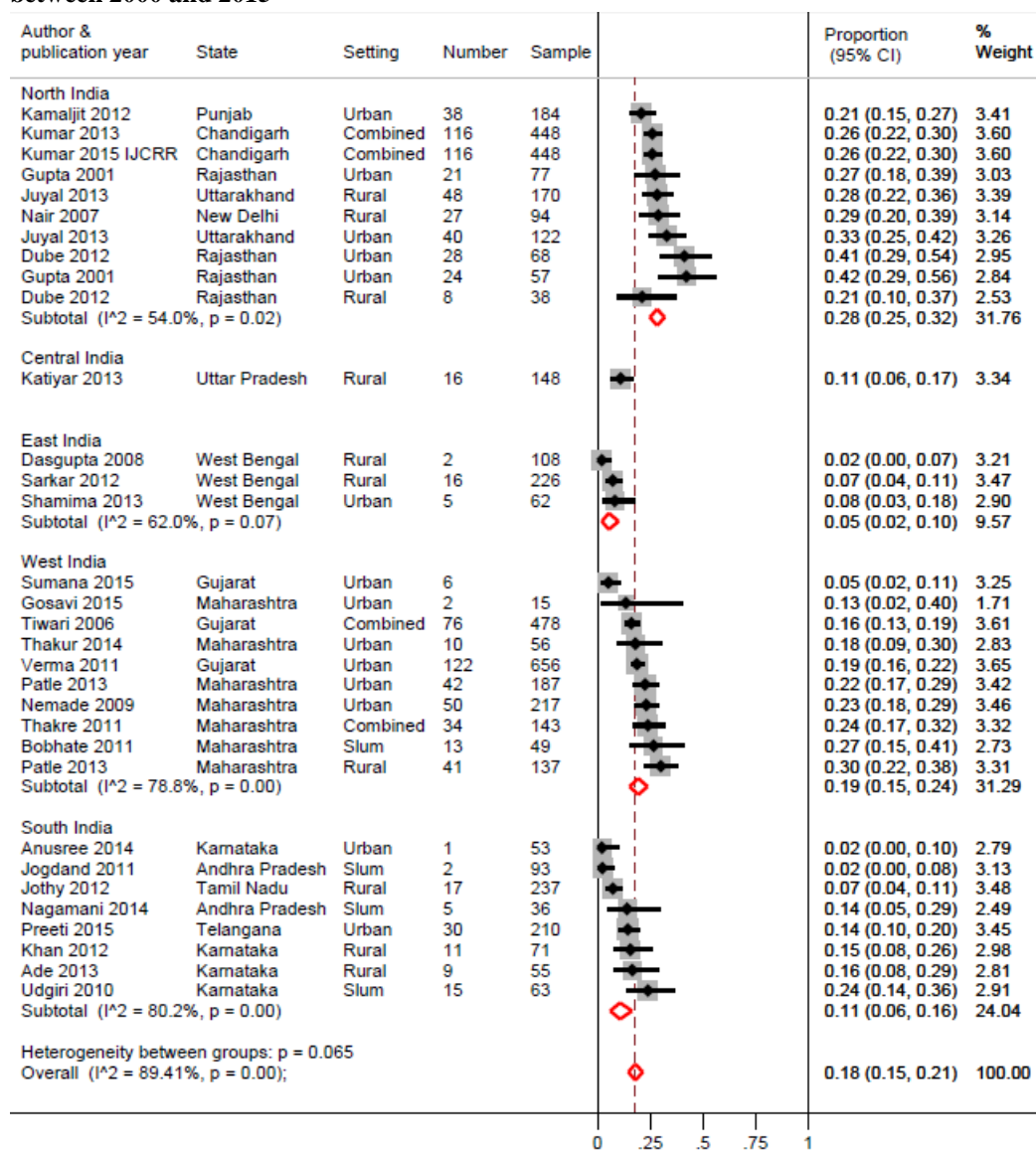


Figure S3.5: Teachers as source of awareness of menarche among adolescent girls by region, studies published in India between 2000 and 2015

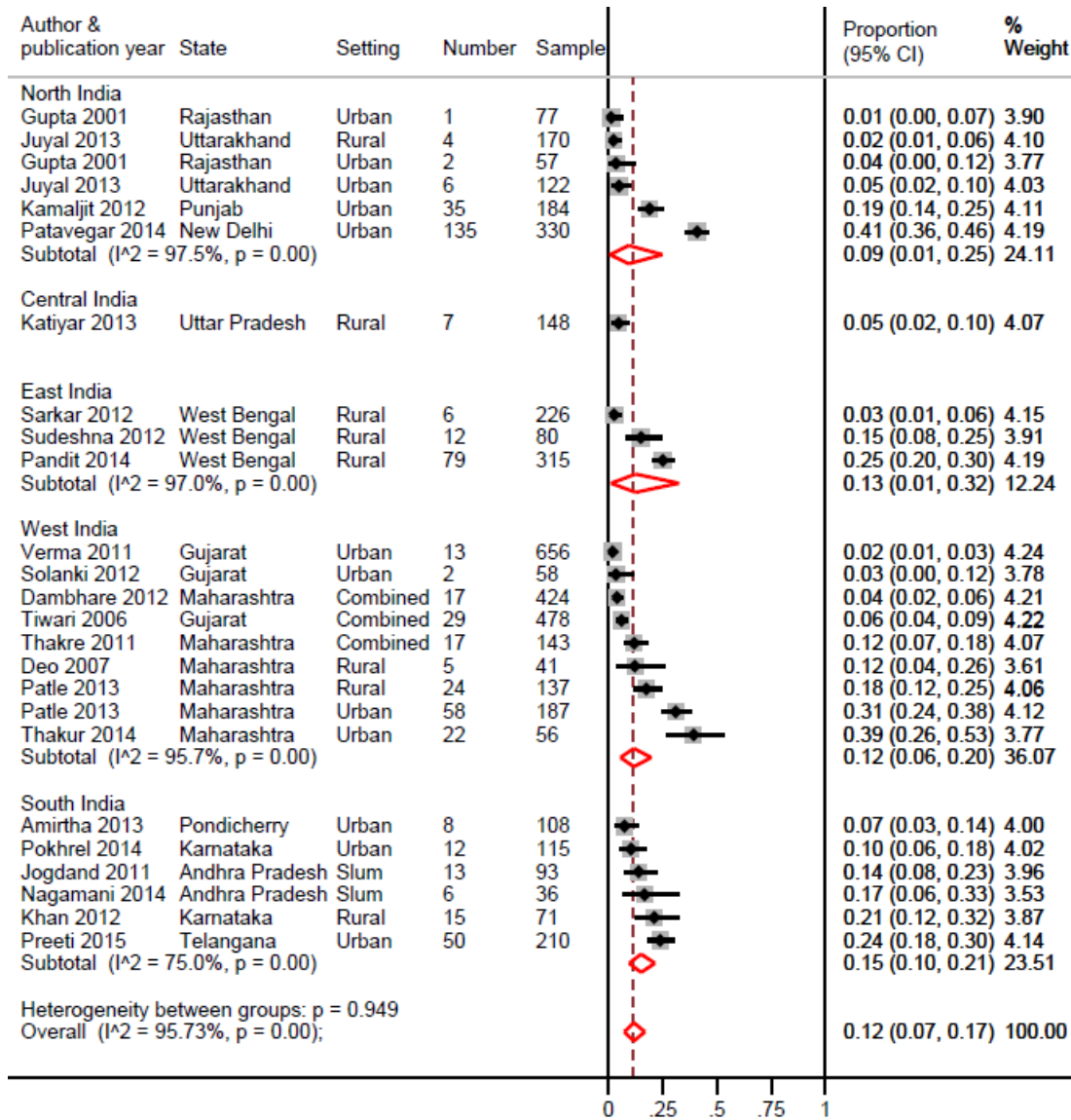


Figure S3.6: Media (books or electronic) as source of awareness of menarche among adolescent girls by region, studies published in India between 2000 and 2015

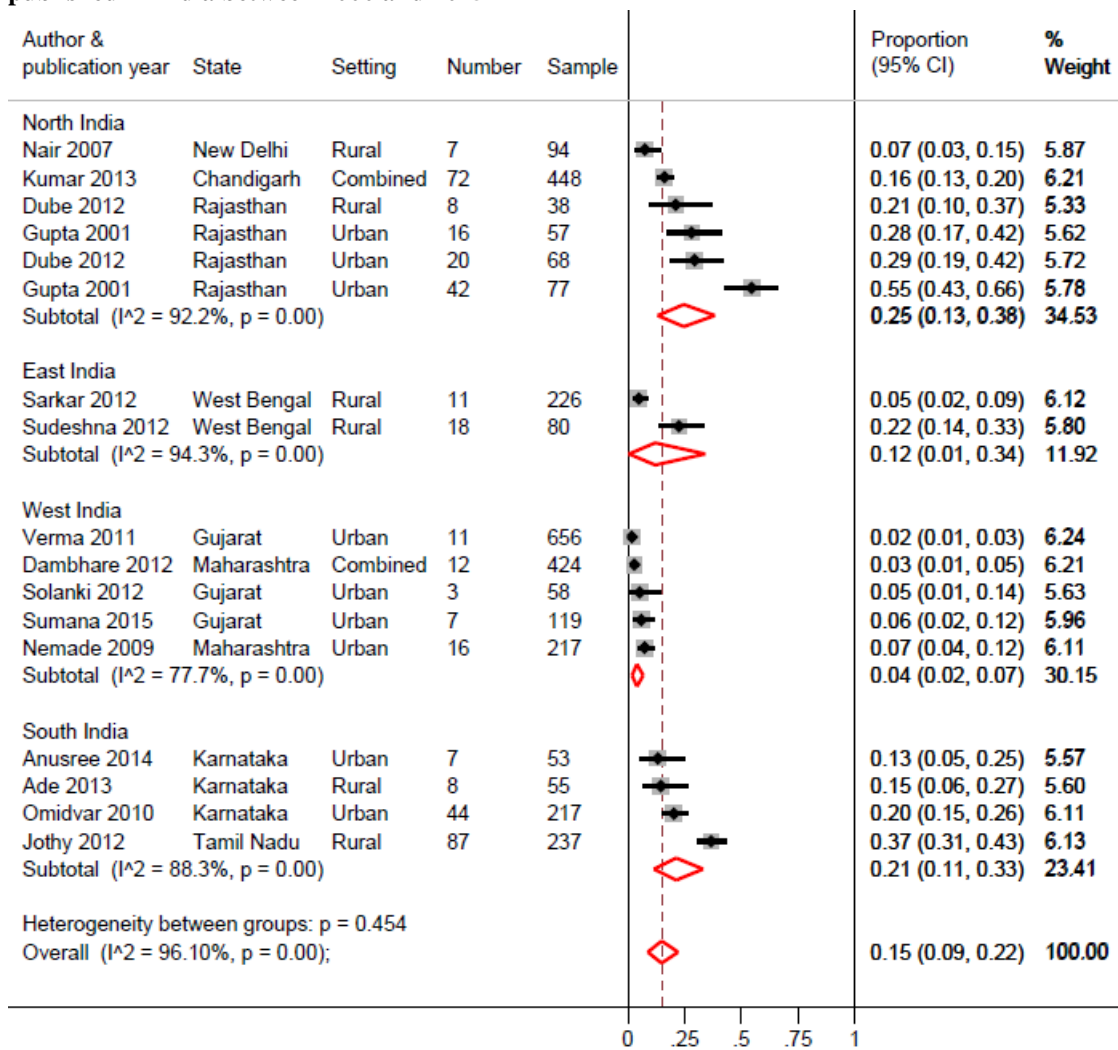


Figure S3.7: Health workers as source of awareness of menarche among adolescent girls by region, studies published in India between 2000 and 2015

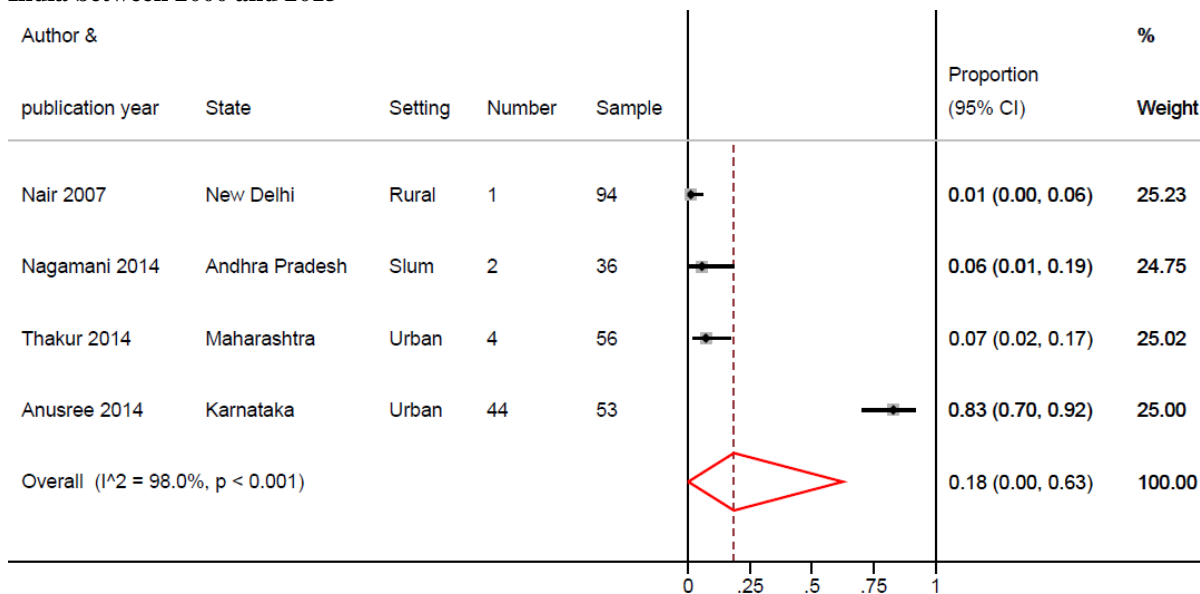


Figure S3.8: Knowledge of uterus as source of blood during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

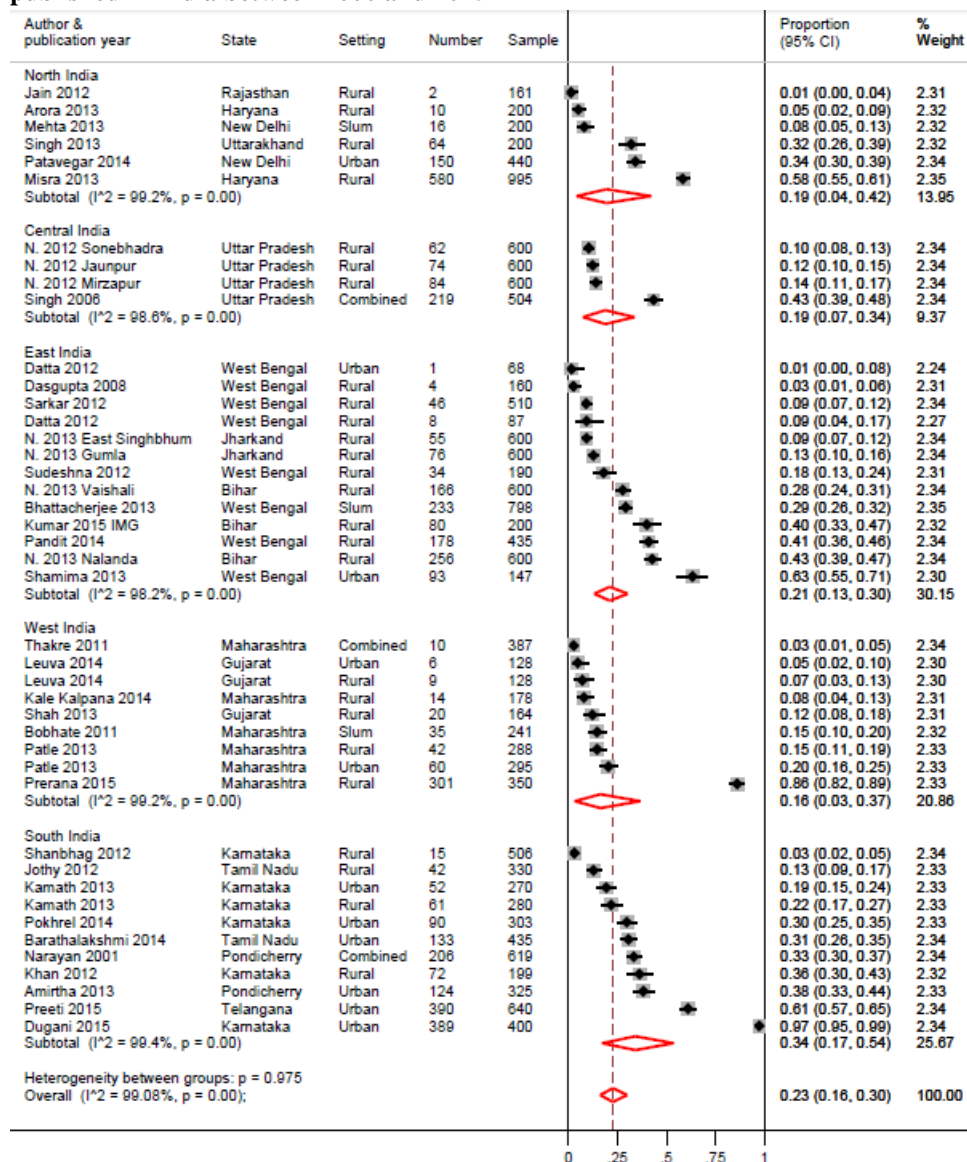


Figure S3.9: Menstruation as a normal phenomenon among adolescent girls by region, studies published in India between 2000 and 2015

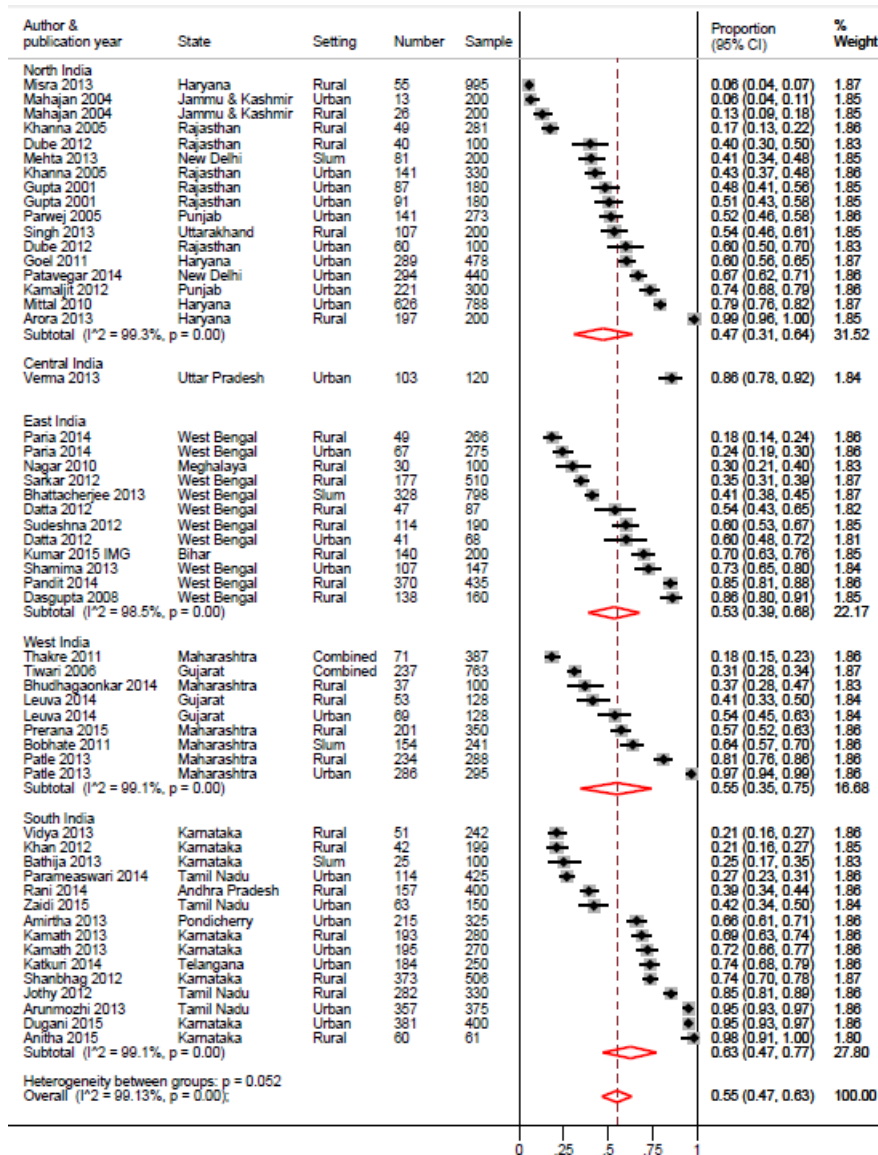


Figure S3.10a: Use of menstrual pads among adolescent girls in the rural setting by region, studies published in India between 2000 and 2015

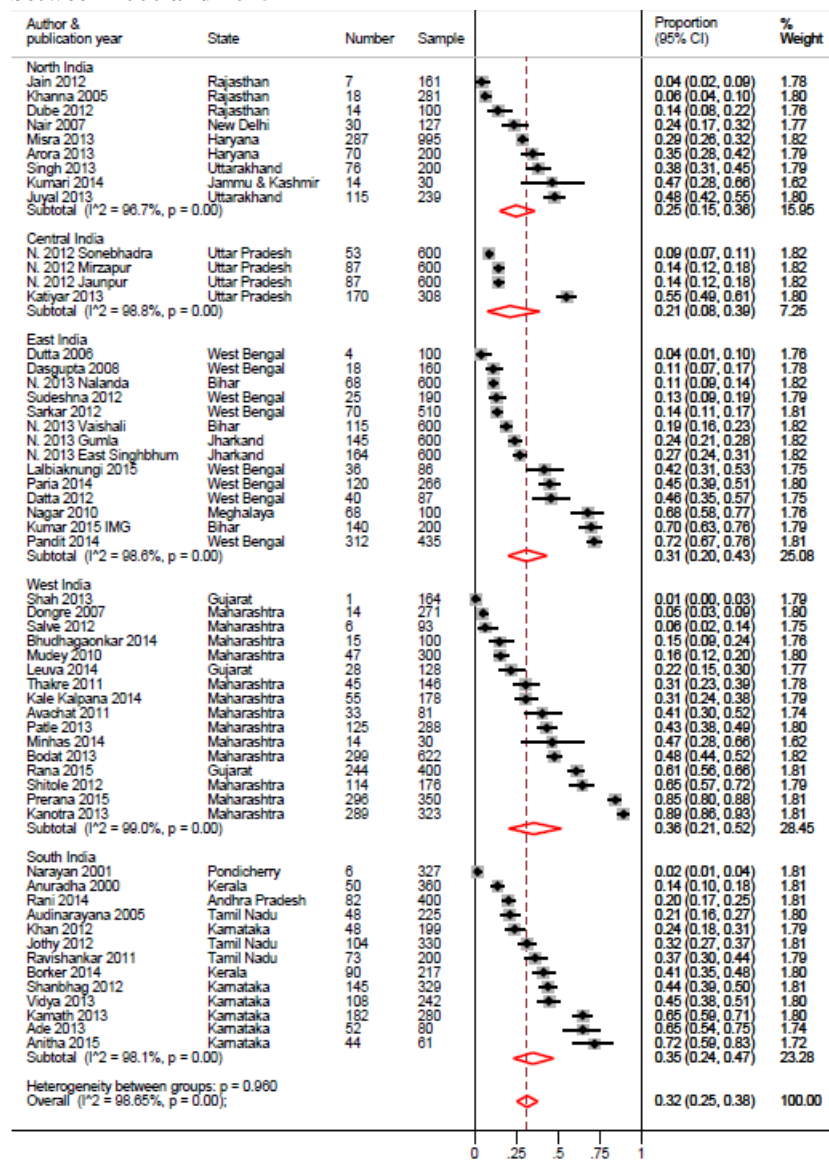


Figure S3.10b: Use of menstrual pads among adolescent girls in settings other than rural by region, studies published in India between 2000 and 2015

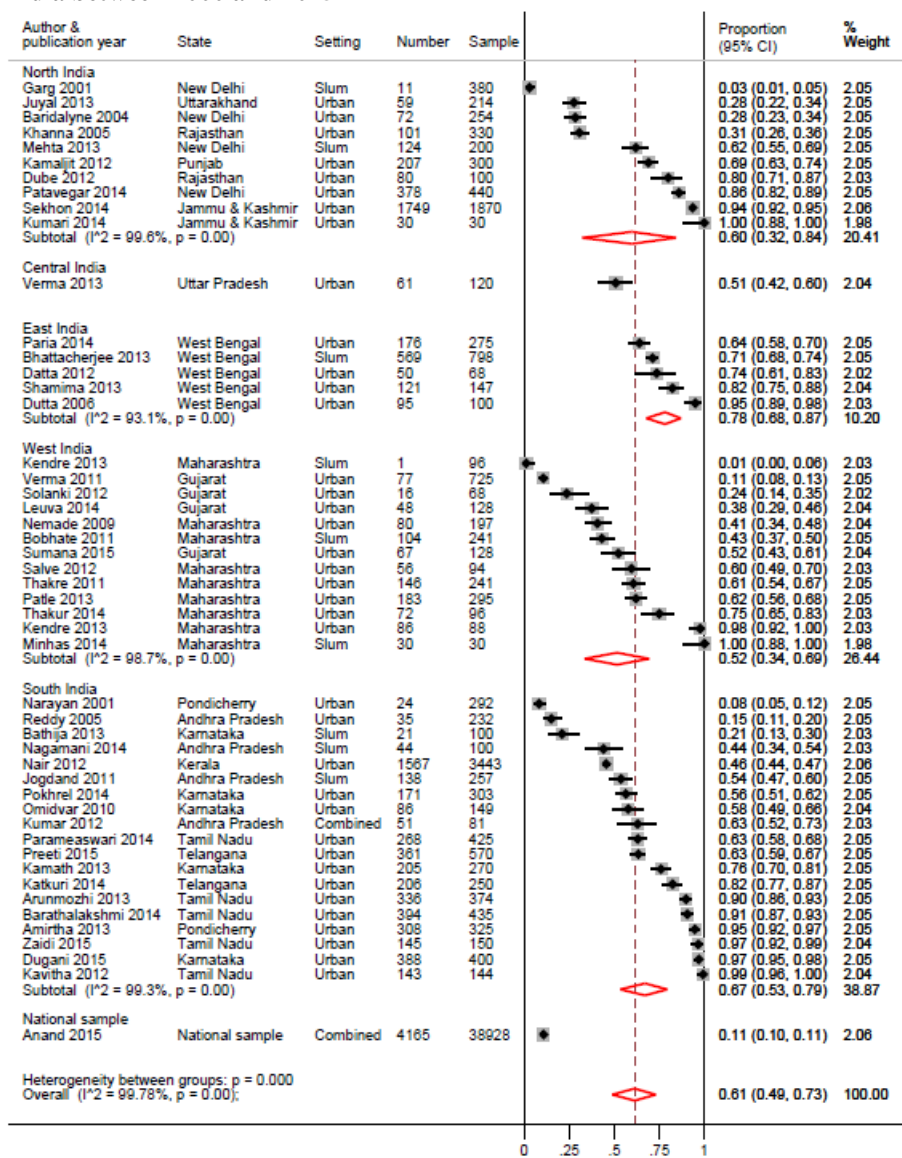


Figure S3.11a: Use of menstrual cloths among adolescent girls in rural settings by region, studies published in India between 2000 and 2015

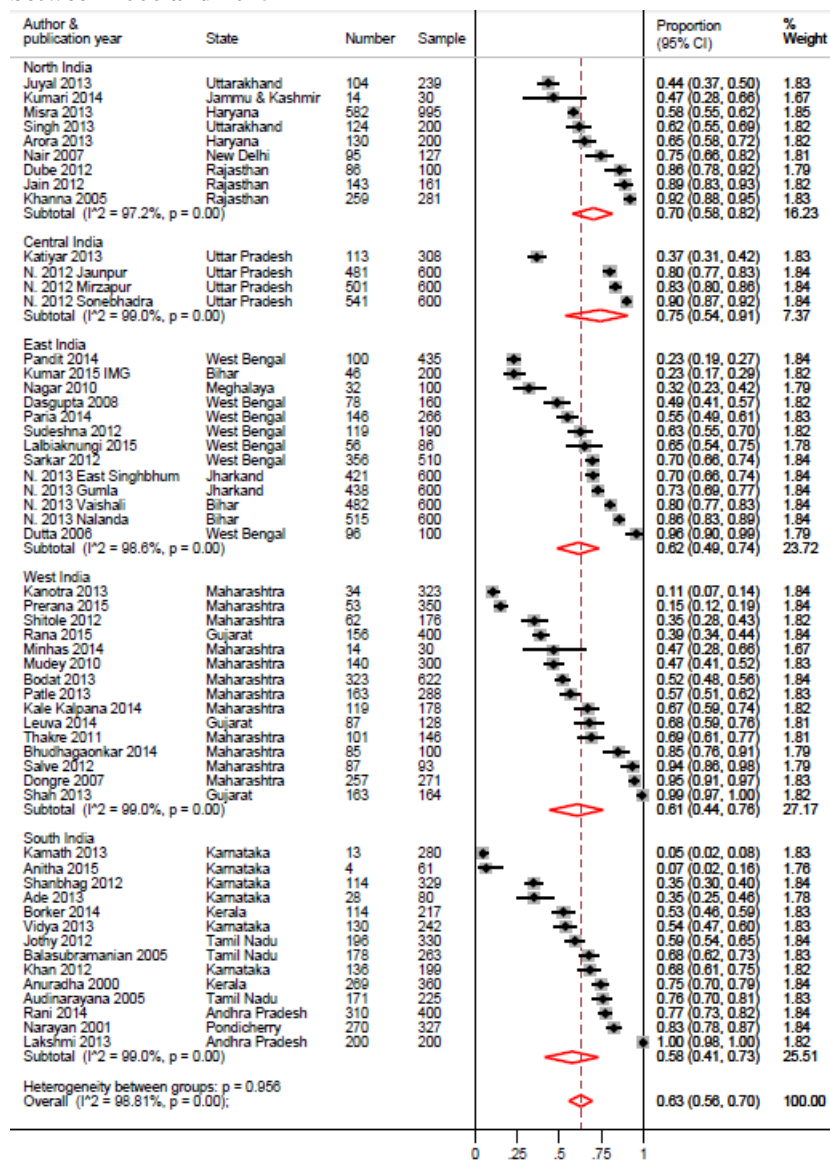


Figure S3.11b: Use of cloths among adolescent girls in settings other than rural by region, studies published in India between 2000 and 2015

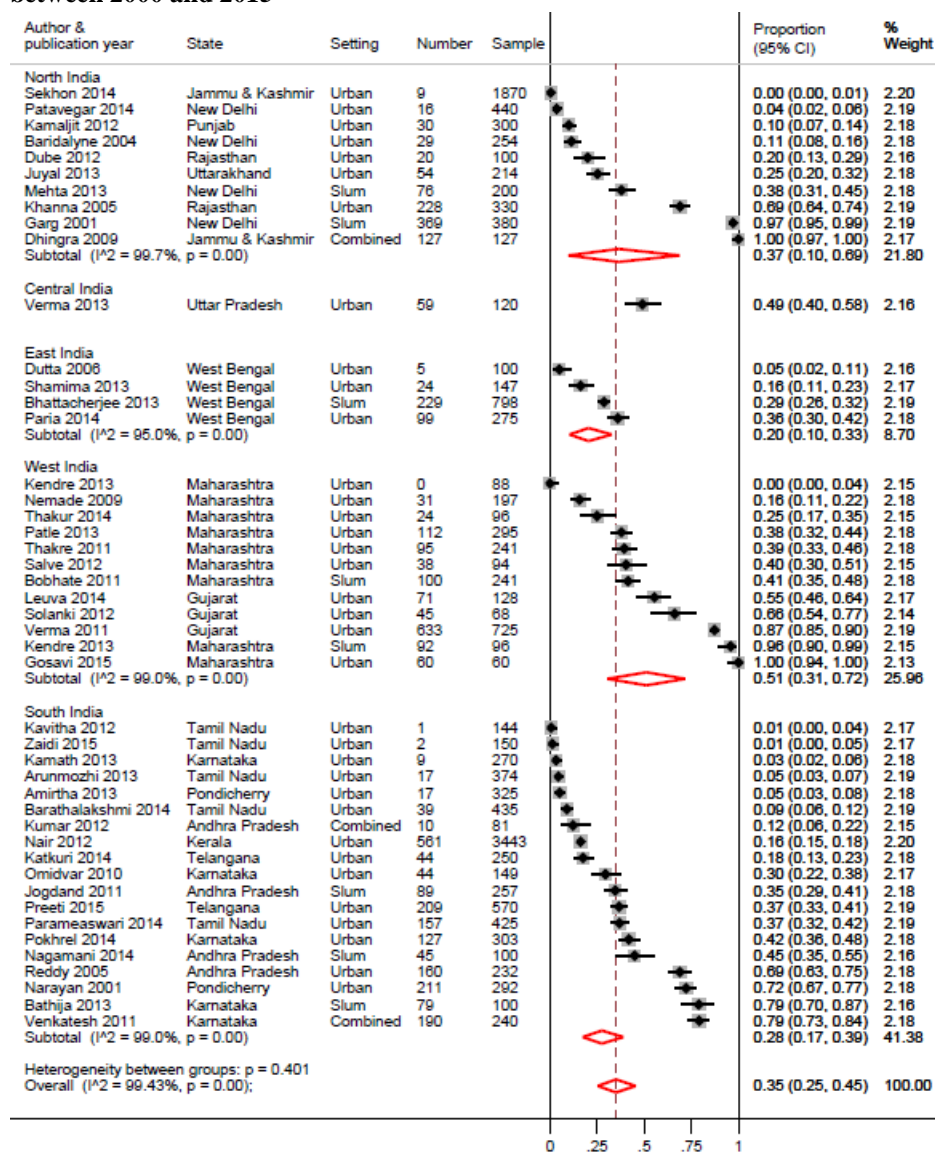


Figure S3.12: Use of the combination of cloths and pads among adolescent girls by region, studies published in India between 2000 and 2015

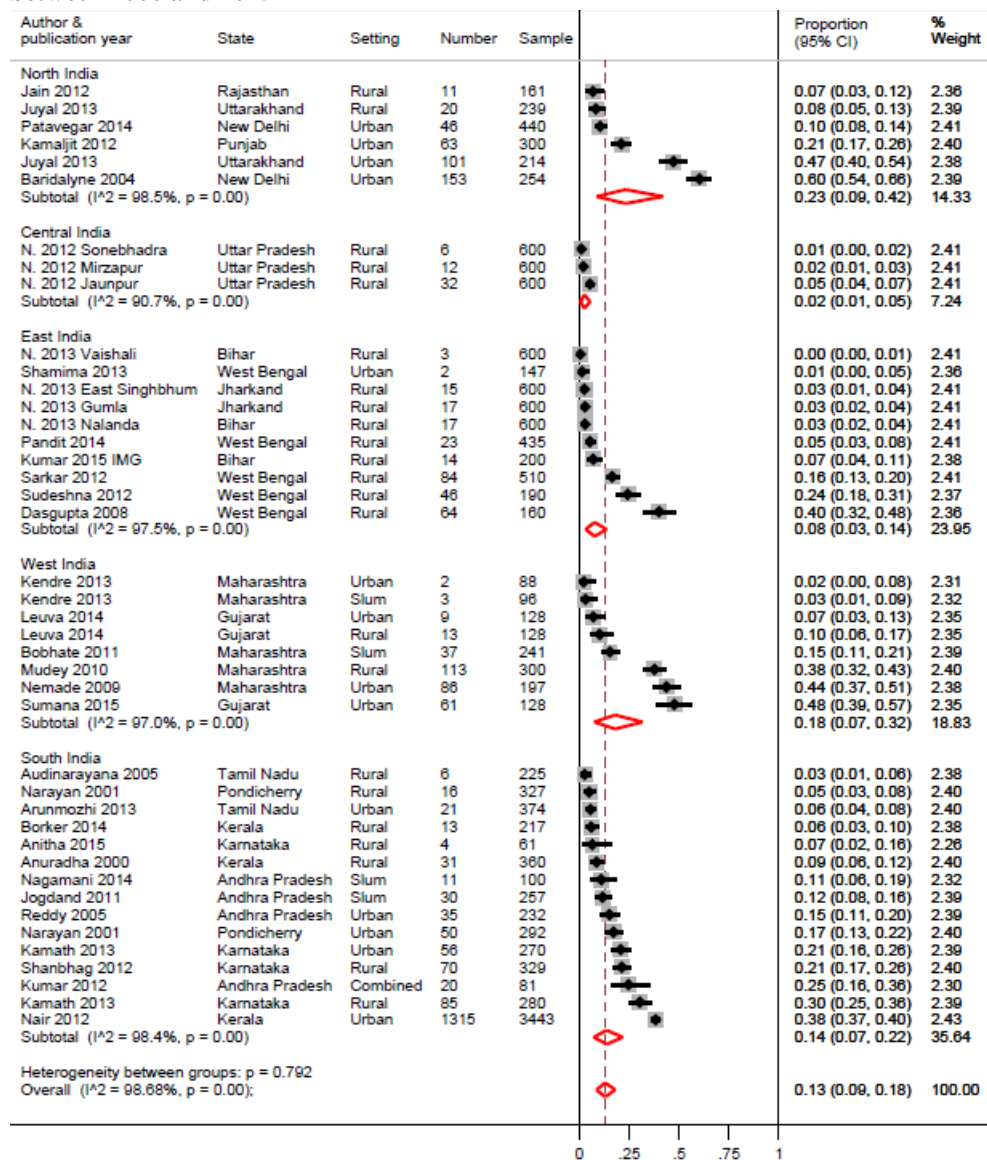


Figure S3.13: Use of routine waste for disposal of absorbent among adolescent girls by region, studies published in India between 2000 and 2015

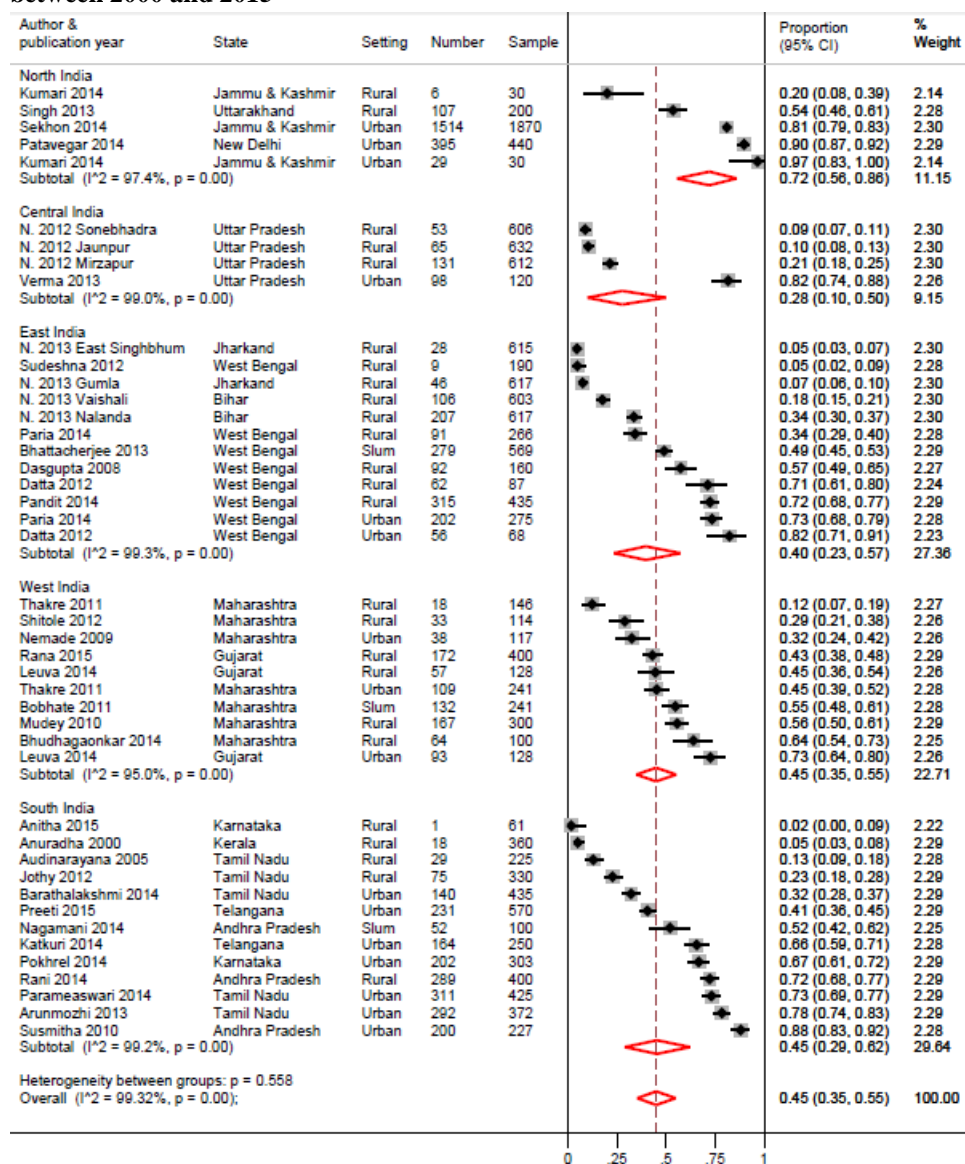


Figure S3.14: Use of burning for disposal of absorbent among adolescent girls by region, studies published in India between 2000 and 2015

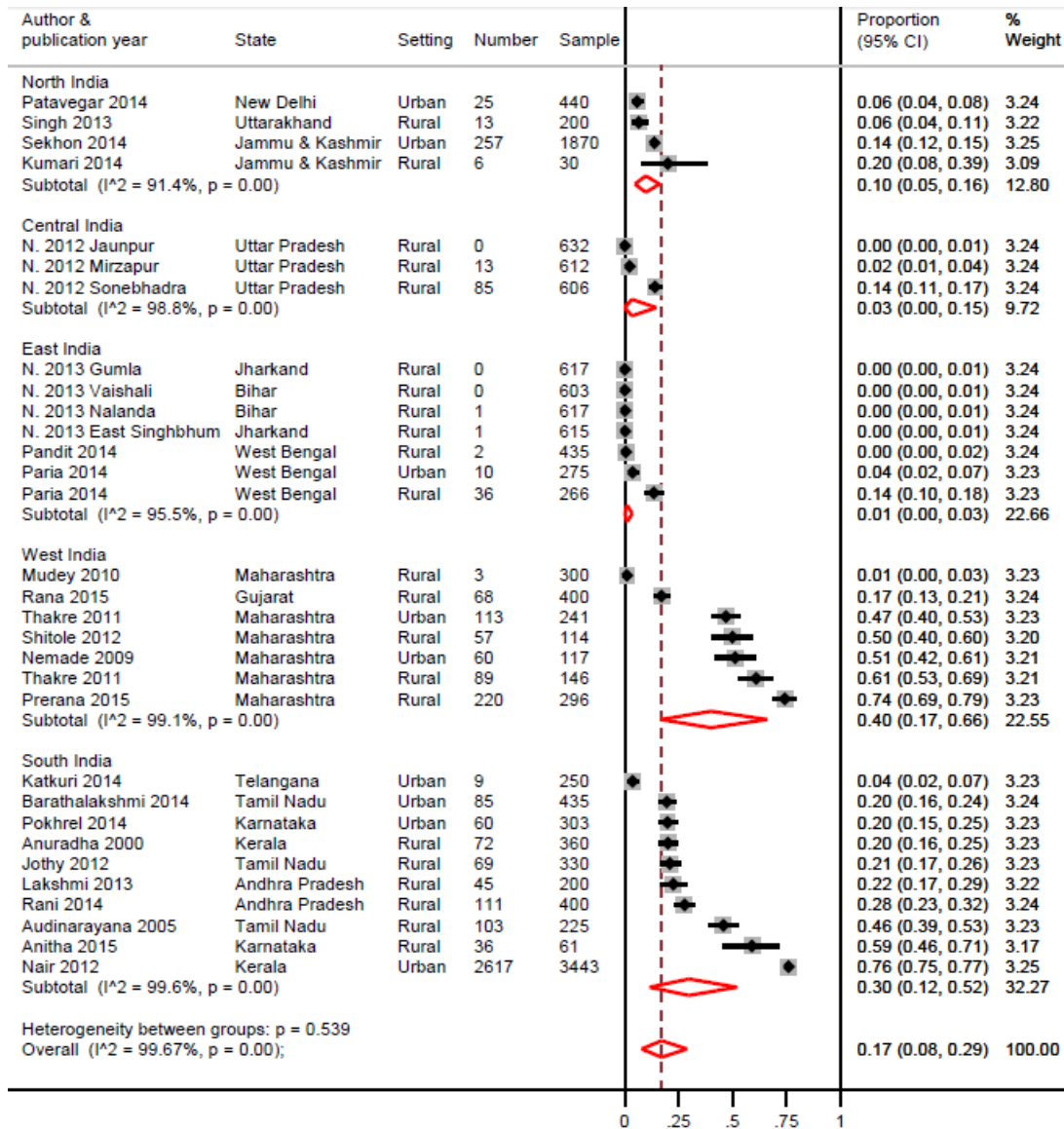


Figure S3.15: Use of burying for disposal of absorbent among adolescent girls by region, studies published in India between 2000 and 2015

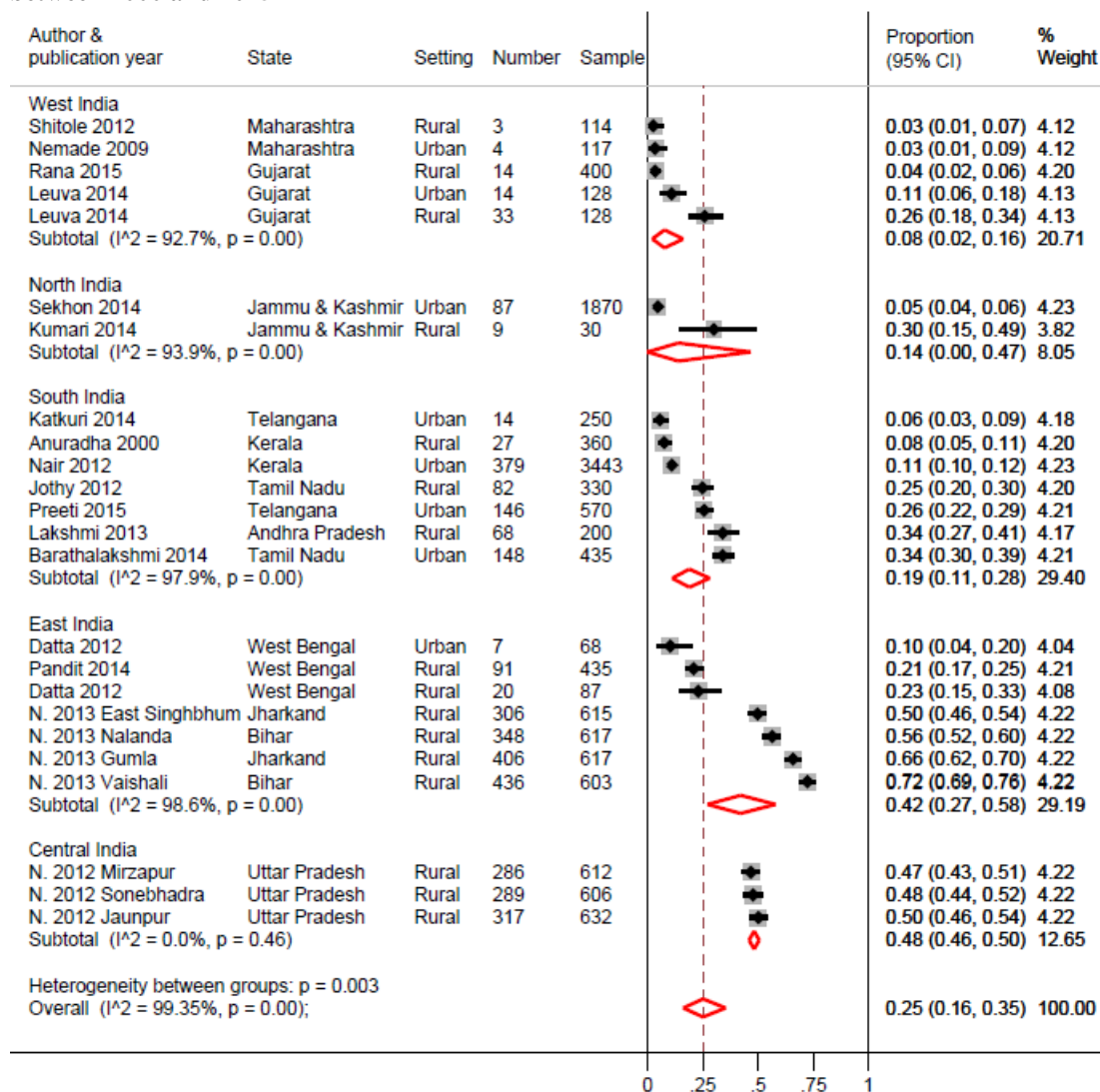


Figure S3.16: “Throwing away” of the absorbent as way of disposal among adolescent girls by region, studies published in India between 2000 and 2015

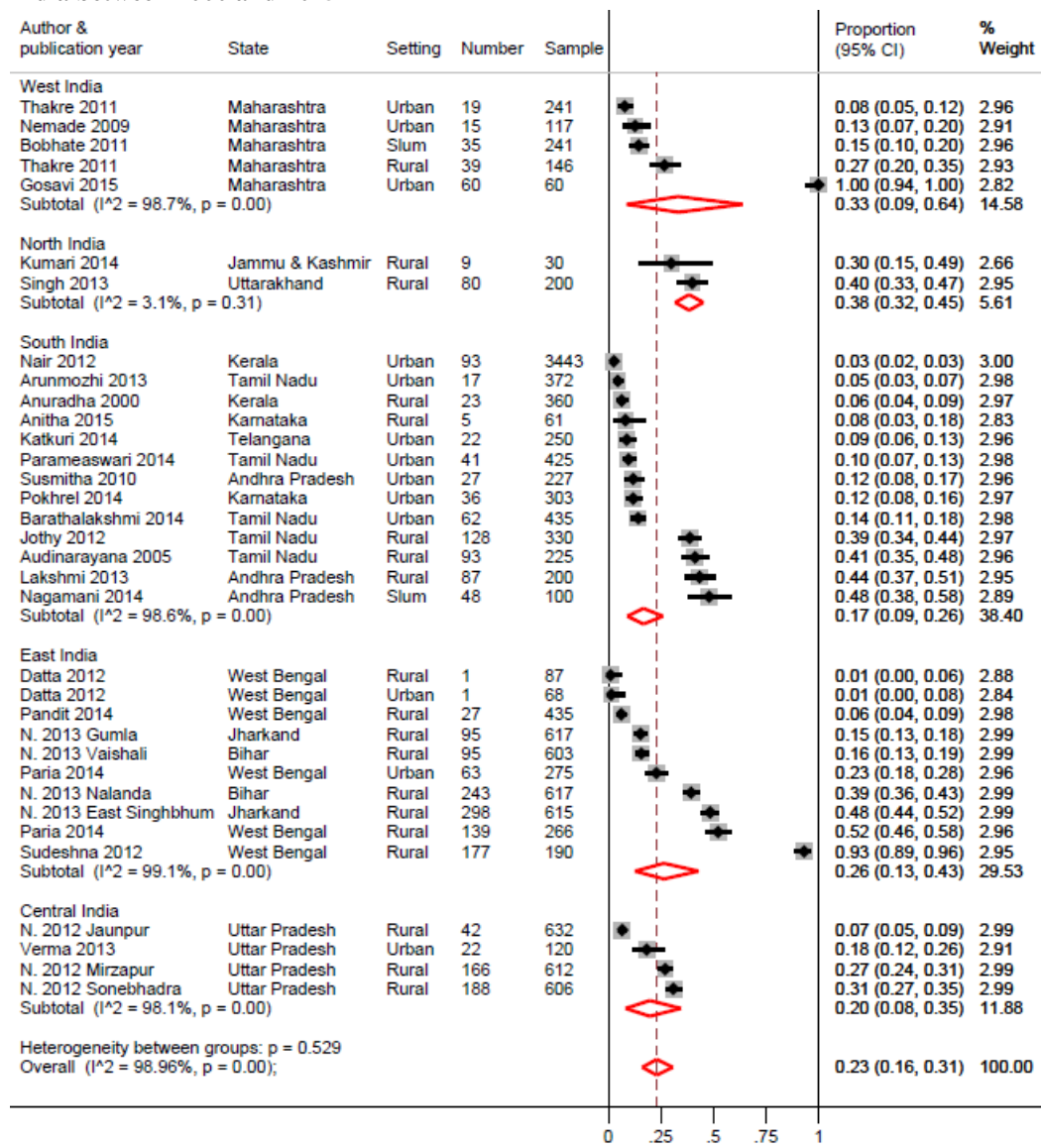


Figure S3.17: “Throwing in toilet” of the absorbent as way of disposal among adolescent girls by region, studies published in India between 2000 and 2015

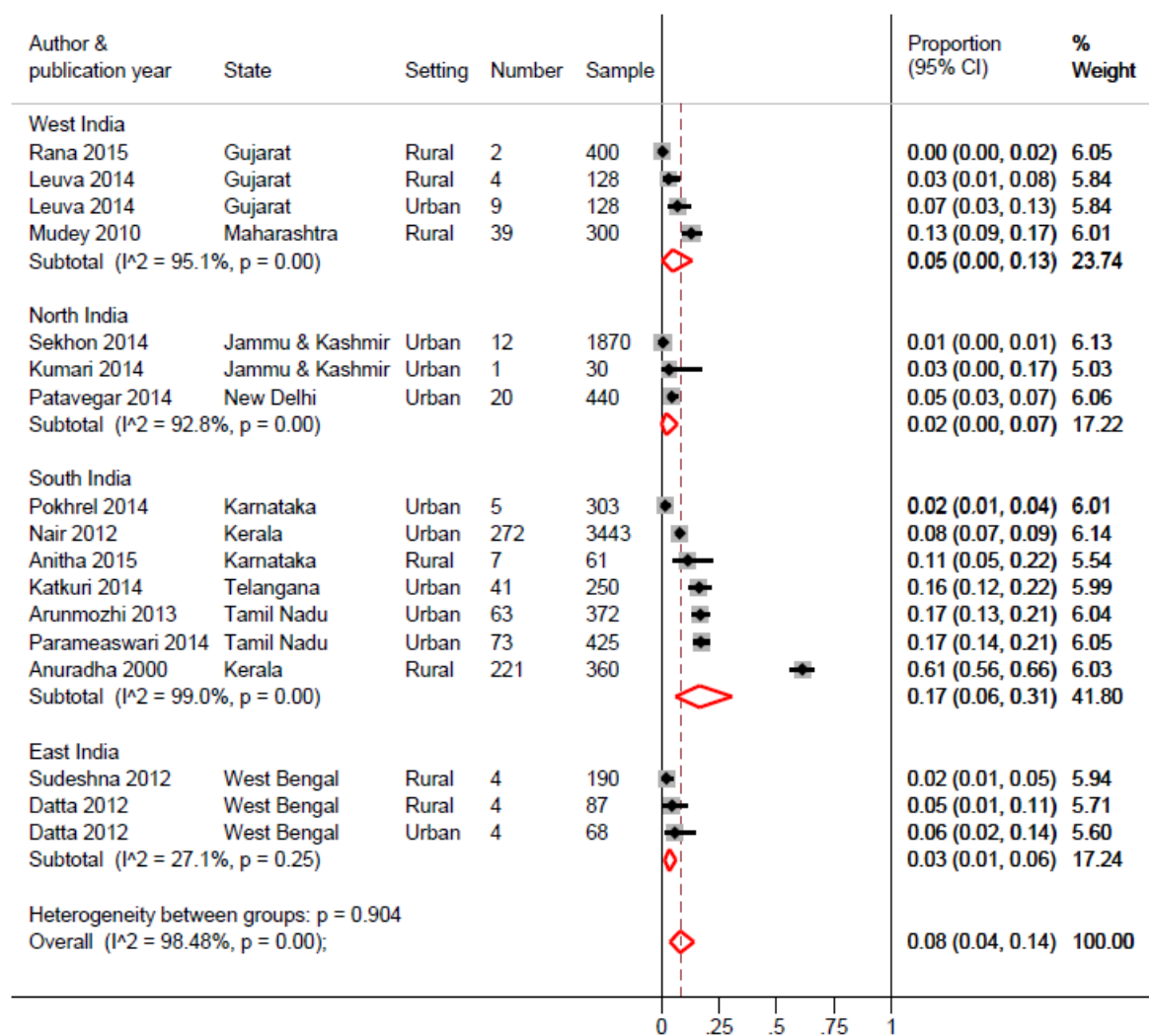


Figure S3.18: Daily bath during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

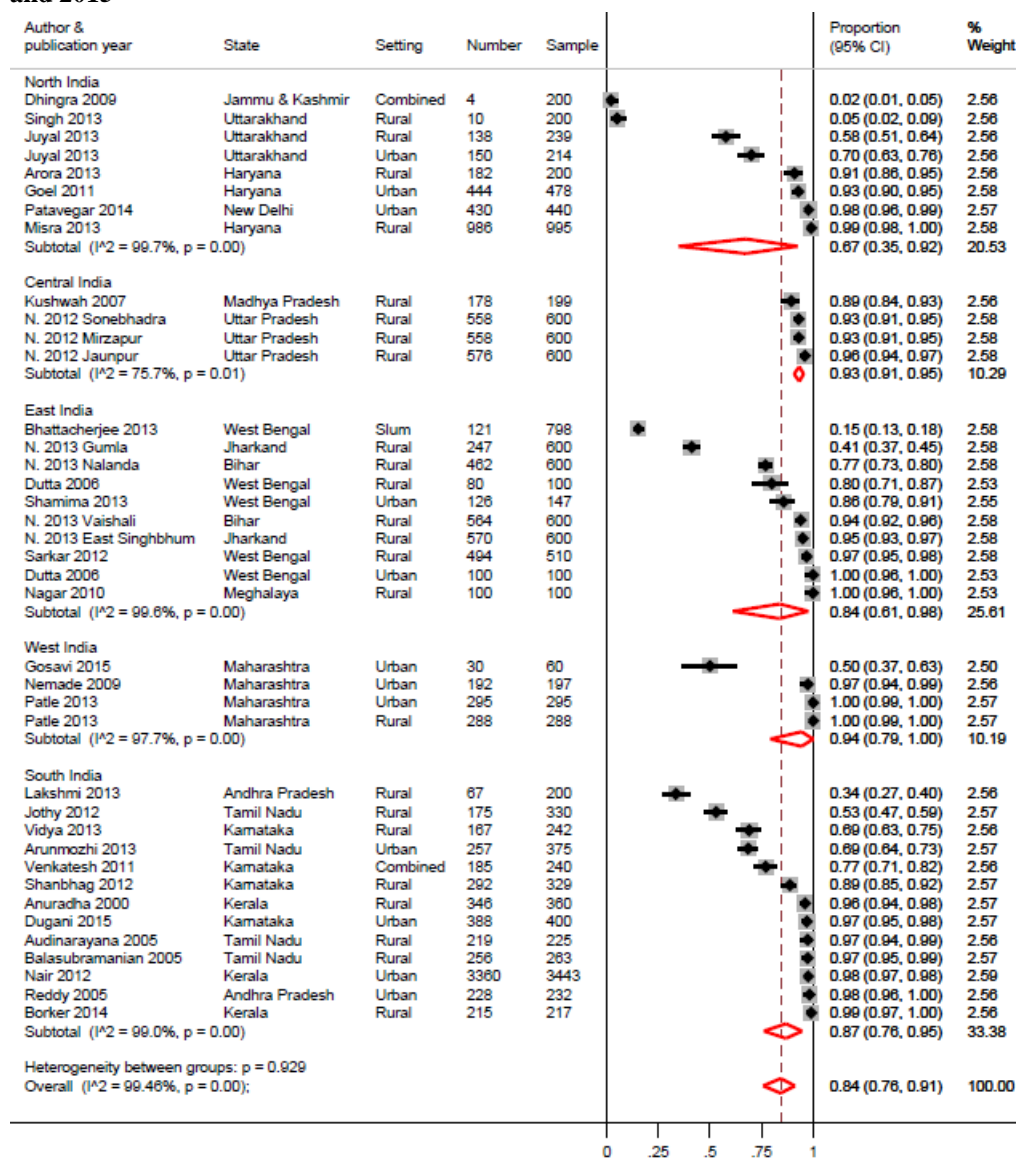


Figure S3.19: Religious restrictions during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

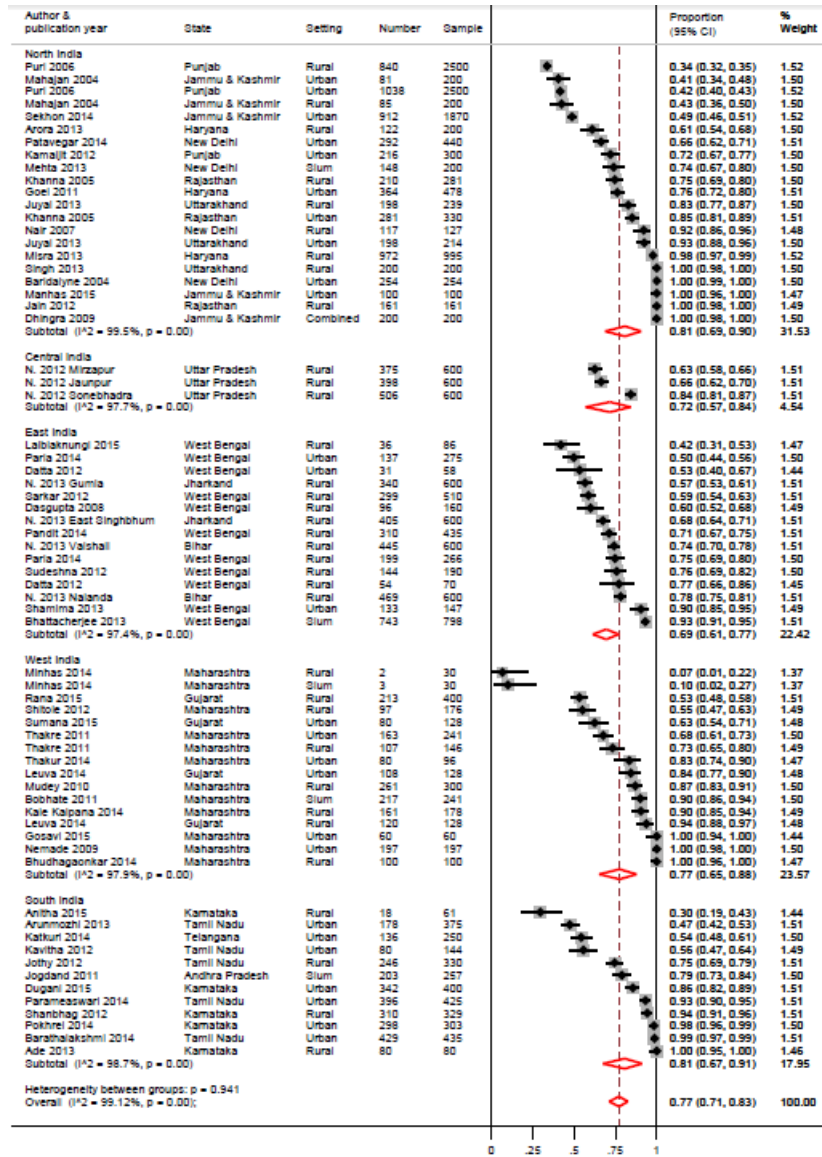


Figure S3.20: Food restrictions during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

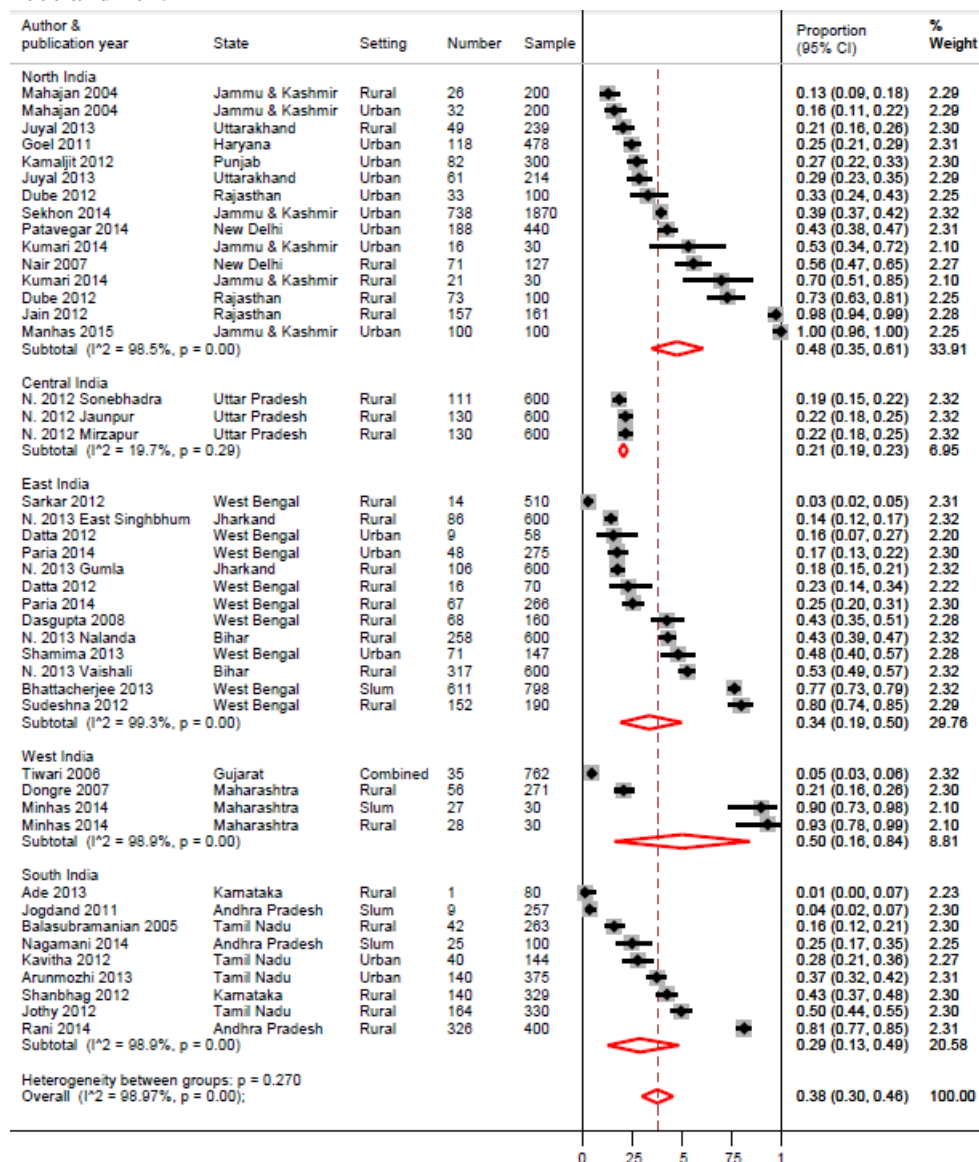


Figure S3.21: Exercise or playing restrictions during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

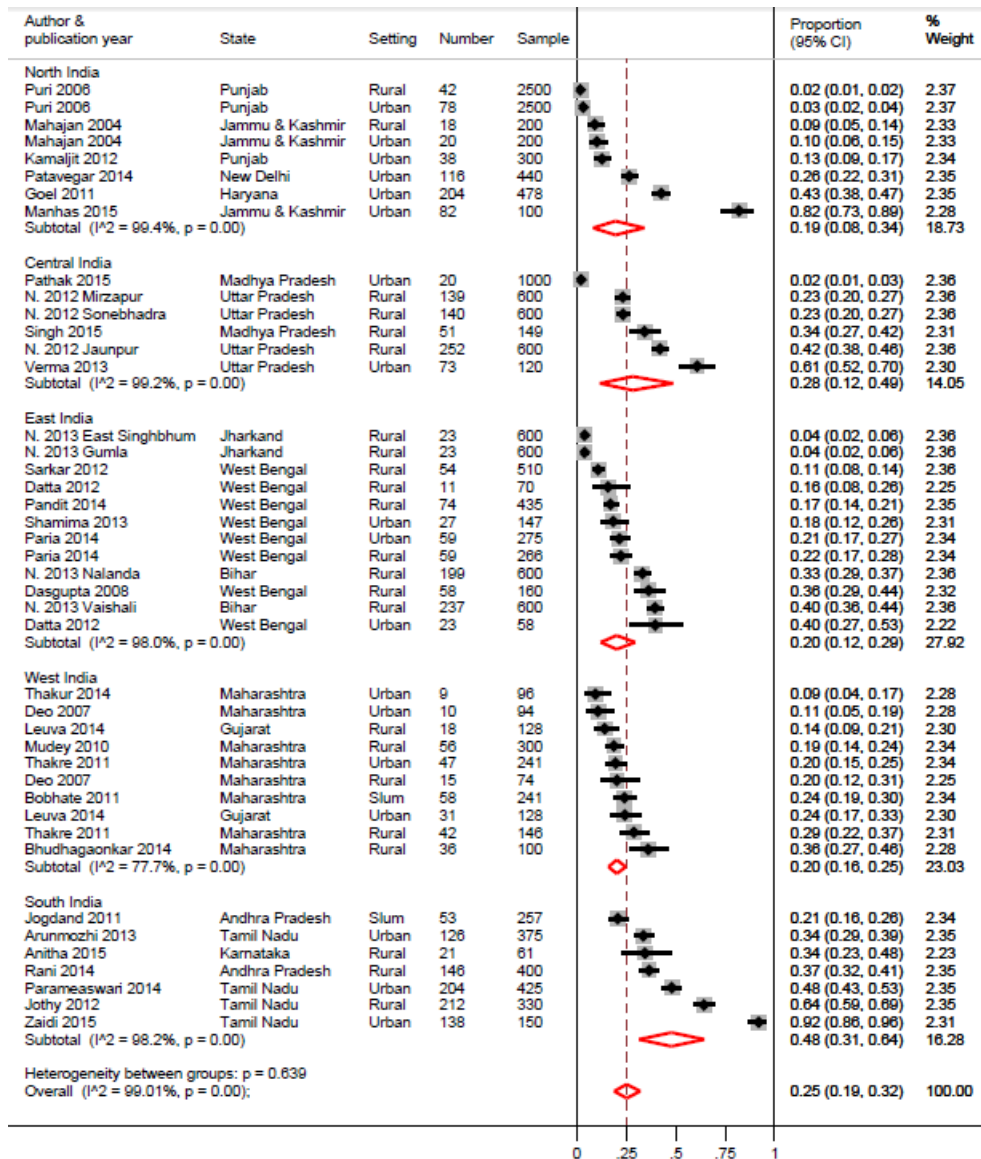


Figure S3.22: Kitchen work or cooking restrictions during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

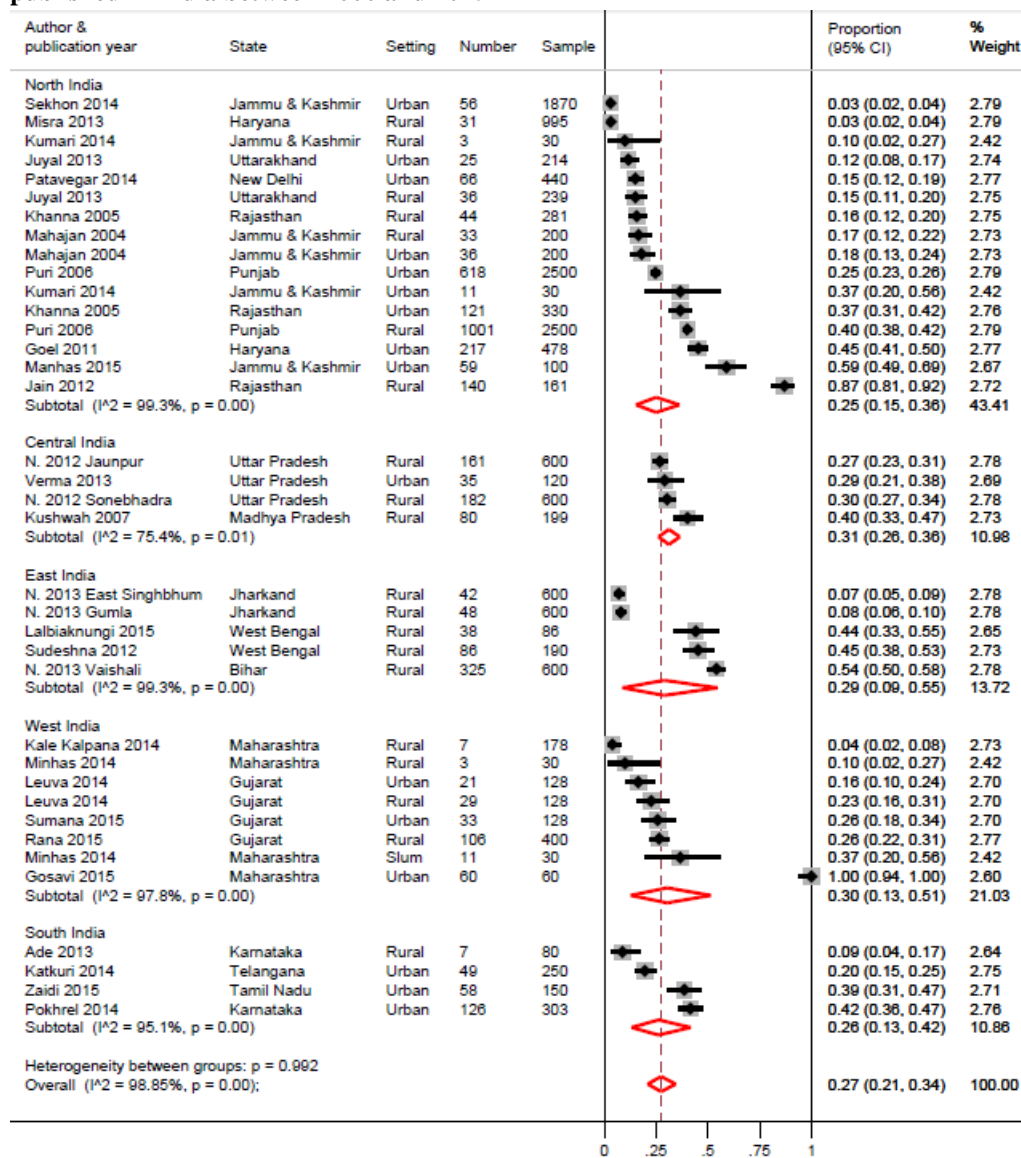


Figure S3.23: Household work restrictions during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

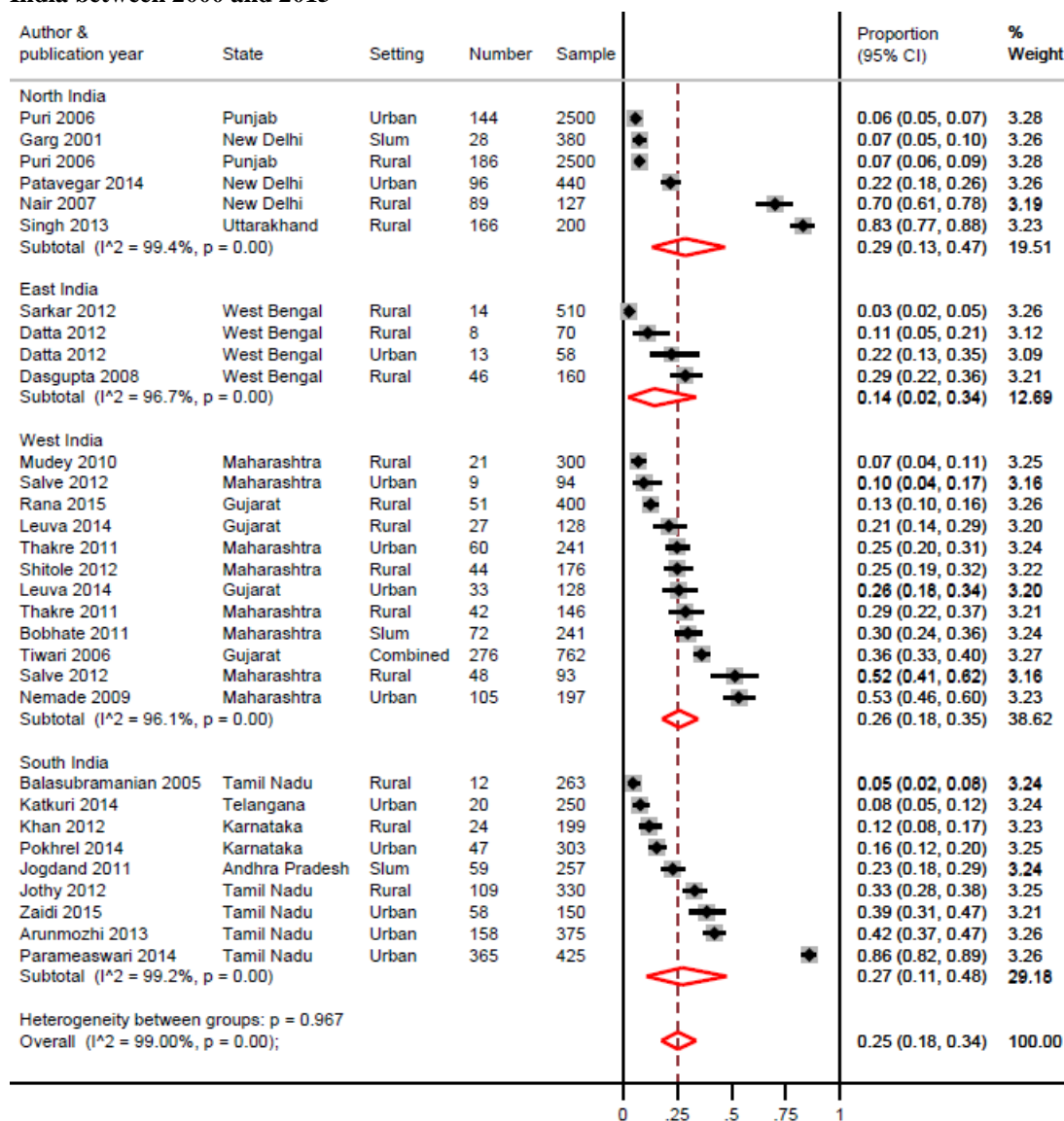


Figure S3.24: Restrictions with regards to leaving the house or isolation during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

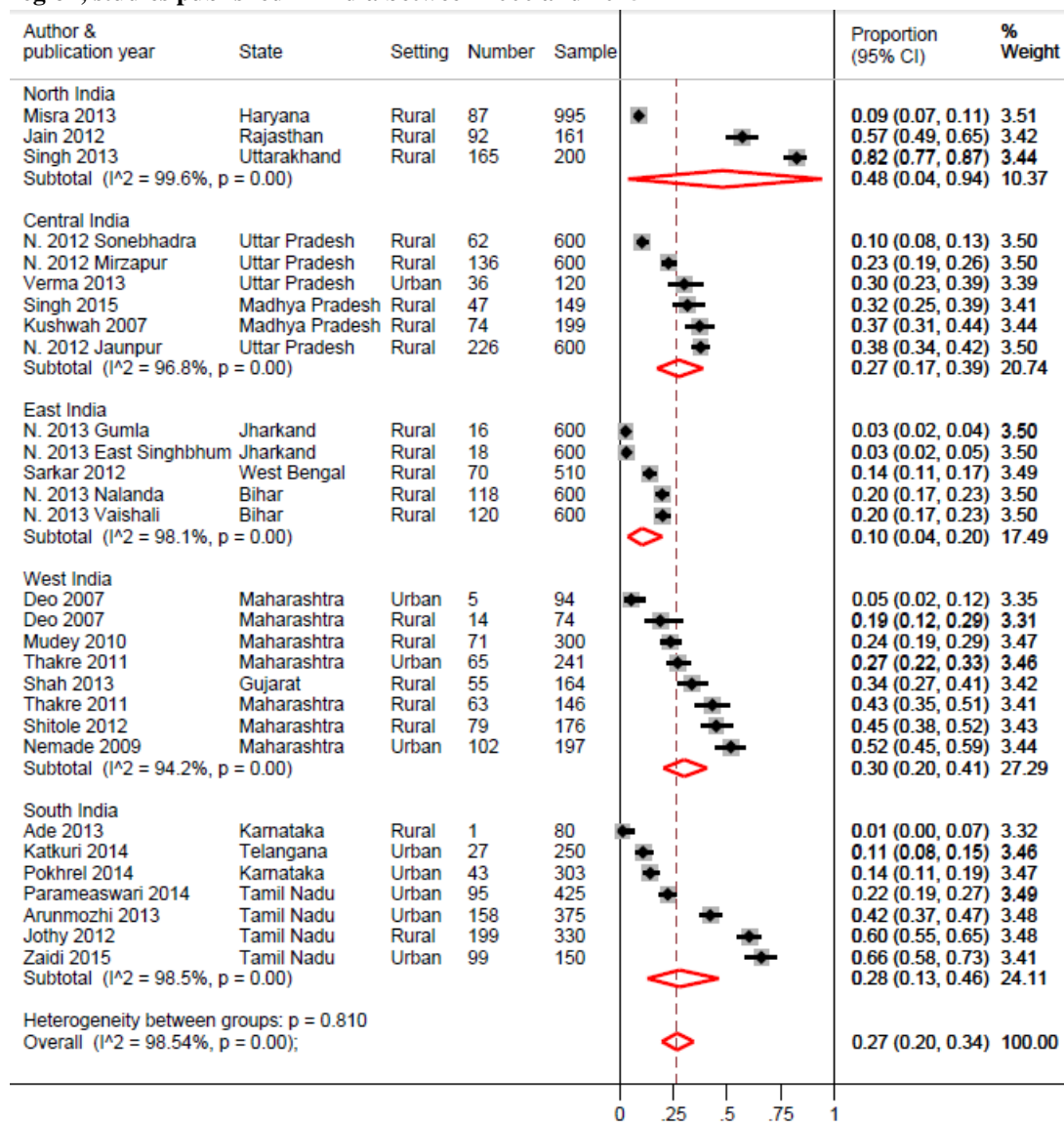


Figure S3.25: Restrictions with regards to attending social functions during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

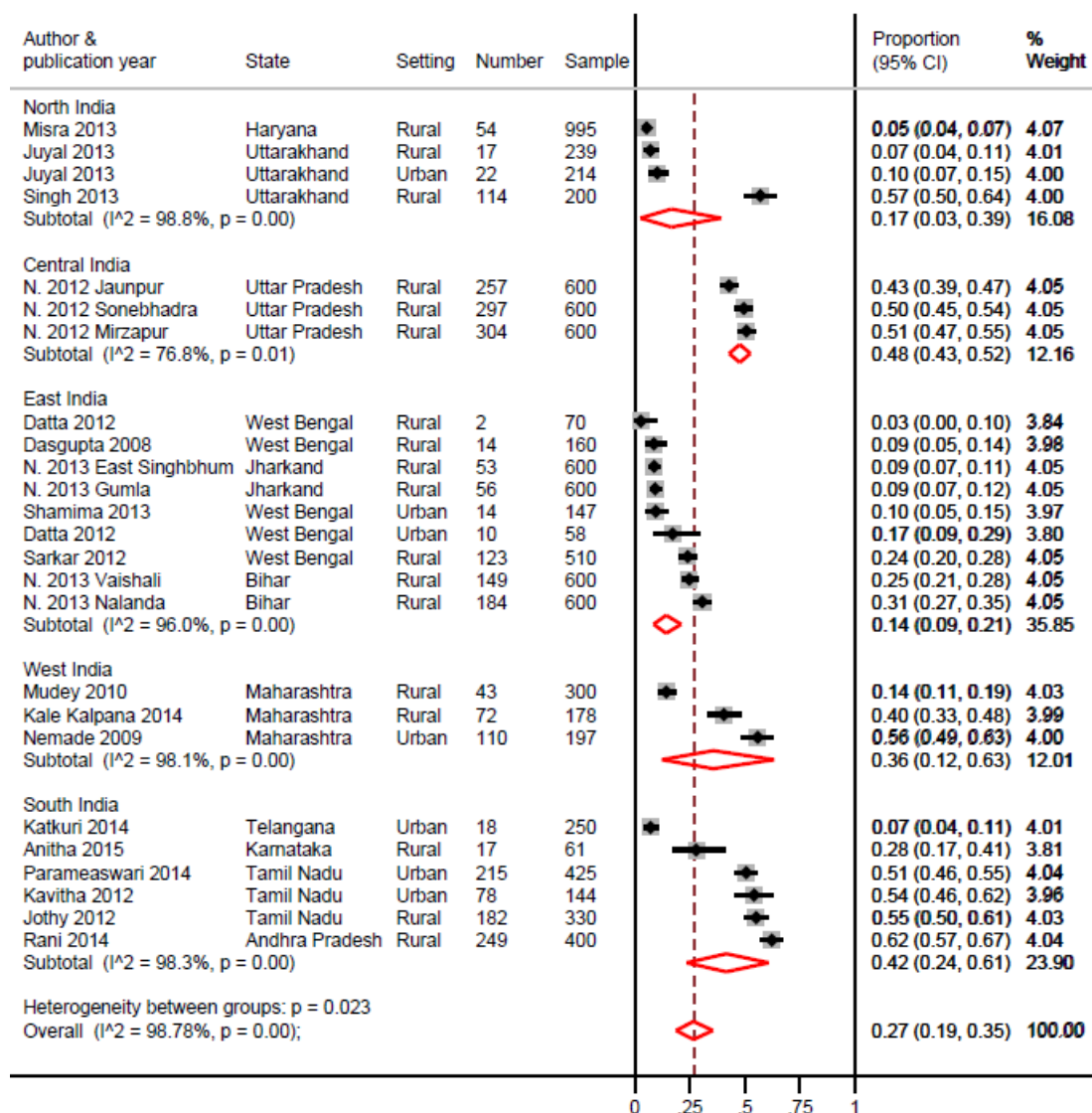


Figure S3.26: Restrictions with regards to place of sleeping during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

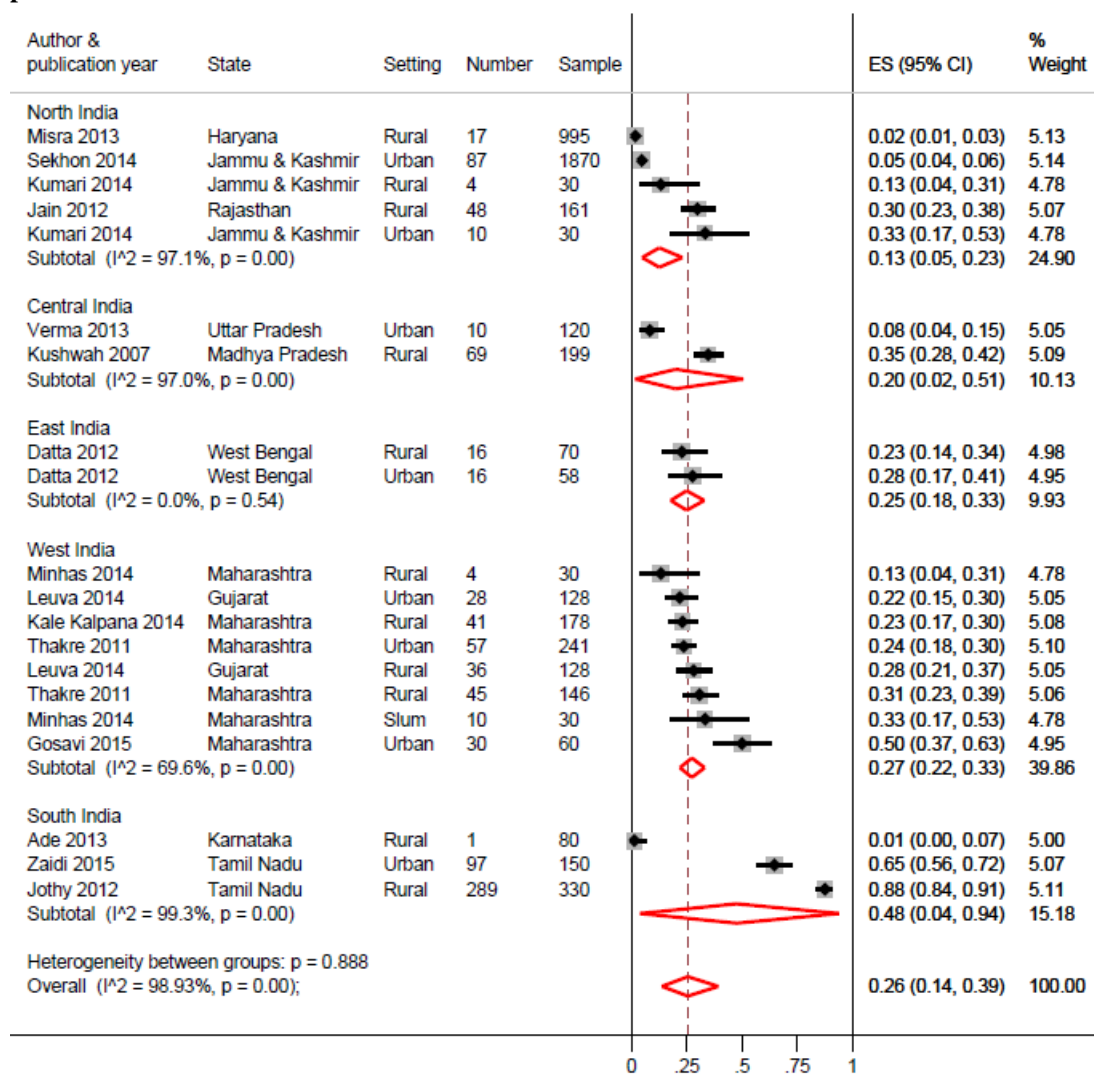


Figure S3.27: Restrictions with regards to touching food or people during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

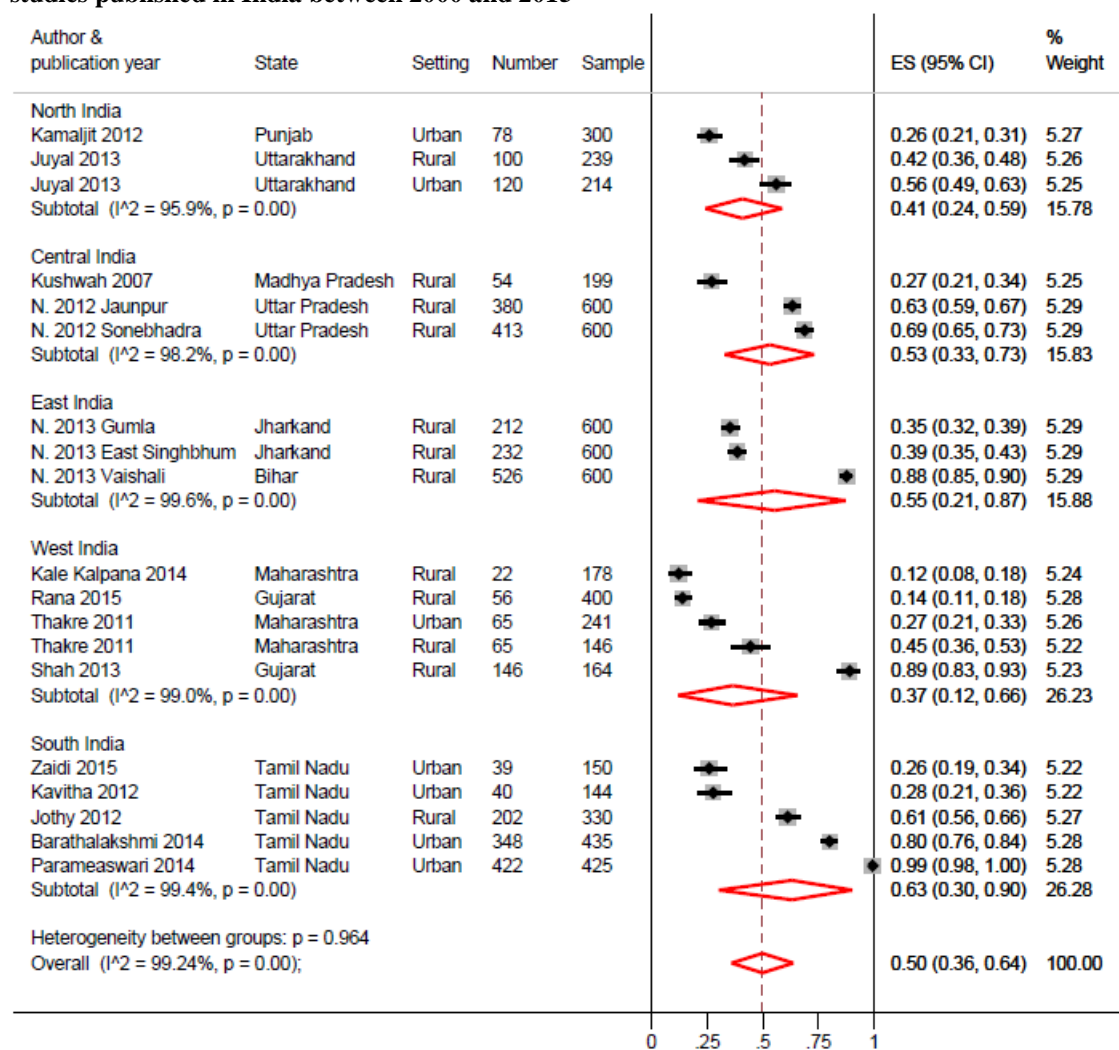


Figure S3.28: Restrictions with regards to sitting arrangements during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

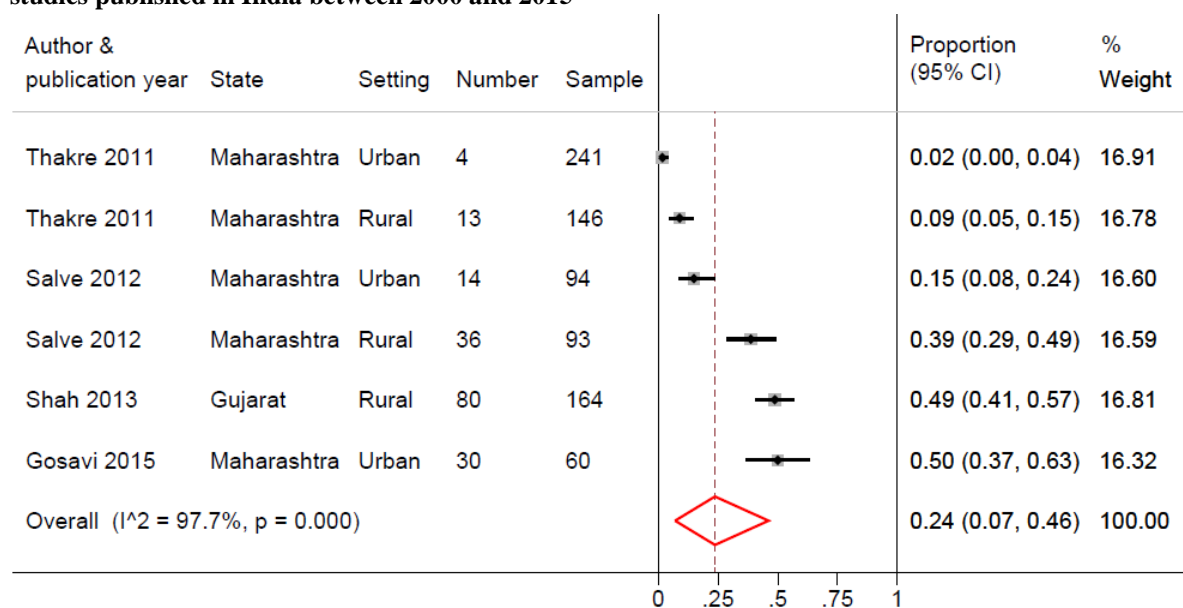


Figure S3.29: No restrictions at all during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

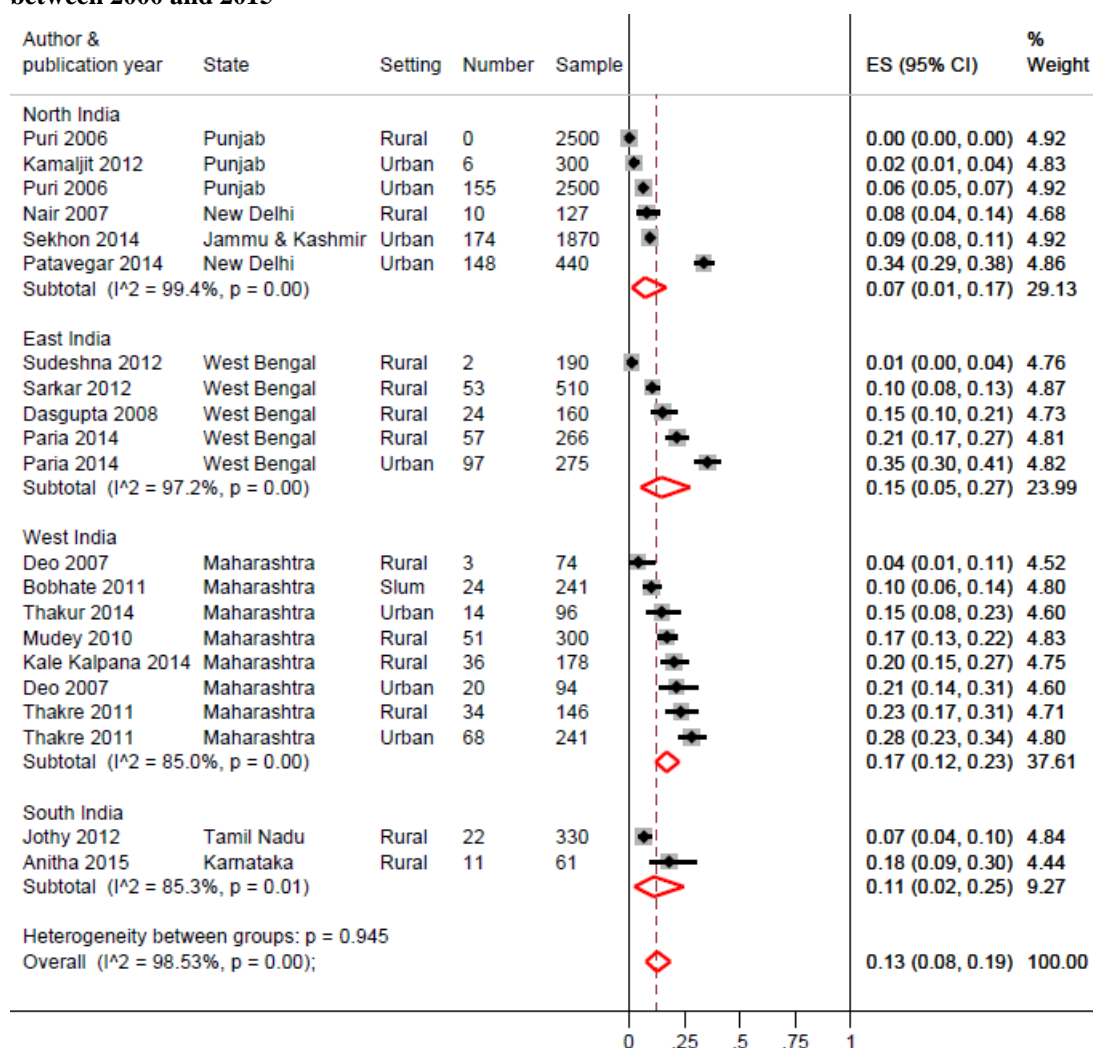


Figure S3.30: School absenteeism because of menstruation among adolescent girls by region, studies published in India between 2000 and 2015

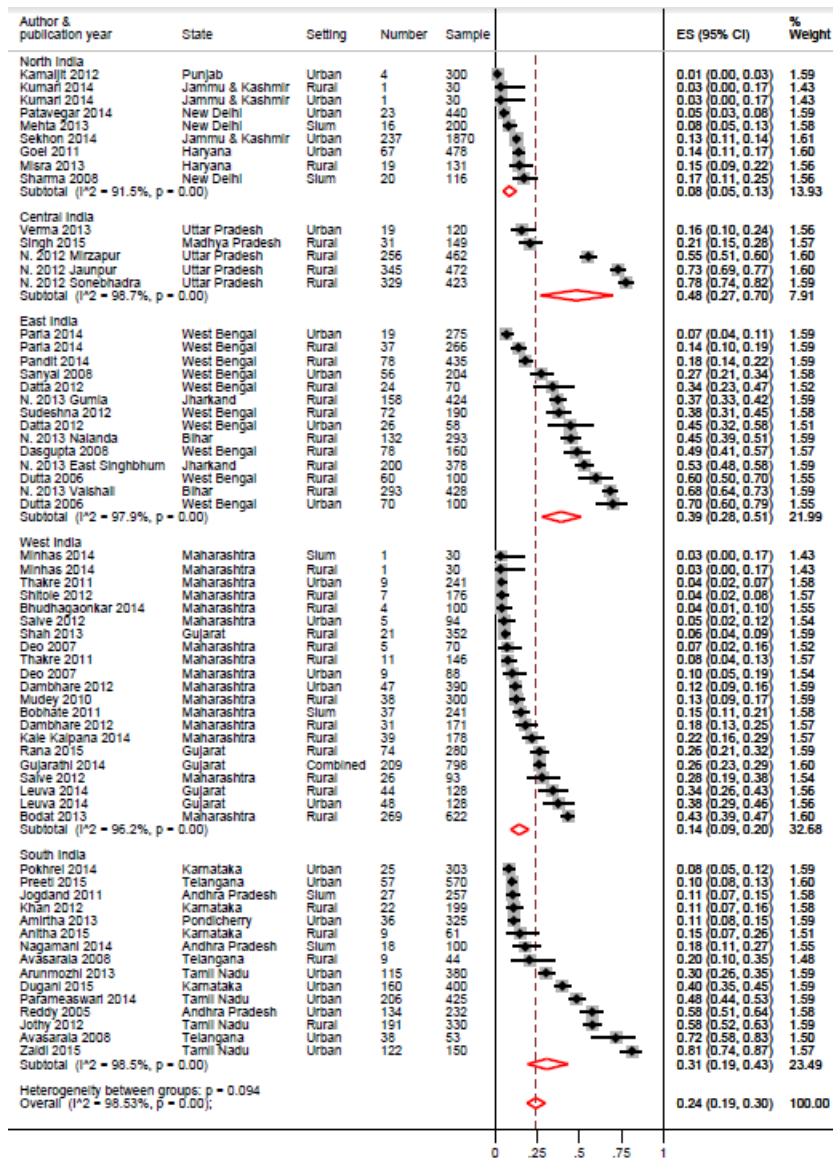


Figure S3.31: Change of absorbent in school during menstruation among adolescent girls by region, studies published in India between 2000 and 2015

