EClinicalMedicine 20 (2020) 100309

Contents lists available at ScienceDirect

EClinicalMedicine

journal homepage: https://www.journals.elsevier.com/eclinicalmedicine

Research Paper

Access to women physicians and uptake of reproductive, maternal and child health services in India

Nandita Bhan[a,*], Lotus McDougal[b], Abhishek Singh[c], Yamini Atmavilas[d], Anita Raj[e]

[a] Center on Gender Equity and Health, University of California, San Diego, CA, United States
[b] Center on Gender Equity and Health, Department of Medicine, University of California, San Diego, CA, United States
[c] Department of Public Health and Mortality Studies, International Institute for Population Sciences, Mumbai, India
[d] Gender Equality, India Country Office, Bill & Melinda Gates Foundation, New Delhi, India
[e] Division of Social Sciences Director, Center on Gender Equity and Health (GEH), University of California, San Diego, CA, United States

ARTICLE INFO

Article History:
Received 25 January 2019
Revised 20 February 2020
Accepted 20 February 2020
Available online 5 March 2020

Keywords:
Female physicians
Women doctors
Maternal and child health services
Health workforce
Gender equity

ABSTRACT

Background: Low availability of women physicians in rural areas can compromise women's health care seeking, where need can be greatest. We examined the associations between availability of women physicians and maternal and child health service utilization in India.
Methods: We analyzed cross-sectional district-level data from all 256 districts in 18 states, from India's District-Level Household and Facility Survey (2012–13) and the National Family Health Survey (2015–16). Assessed measures included lady medical officers (LMOs) availability at Primary Health Centers (PHCs, which are largely rural serving), modern contraceptive use, antenatal care (ANC), skilled birth attendance (SBA), maternal postnatal care (PNC), infant PNC, and child immunization. Multilevel regression models nesting districts in states examined associations between LMO availability and health service utilization, adjusting for district-level socioeconomic status (SES) indicators (e.g., women's education, household water access), urbanicity, health insurance coverage and sampled PHCs (15 on average) within districts.
Findings: Only 72 of 256 districts (28.1%) reported >50% of PHCs with LMOs. In multivariable models, LMO availability in PHCs was associated with higher district prevalence (%) of modern contraceptive use [β=0.04 (95% CI: 0.007, 0.08)], 4+ ANC [β =0.07 (95% CI: 0.008, 0.13)], skilled birth attendance [β=0.09 (0.03, 0.14) and maternal PNC [β=0.08 (95% CI: 0.03, 0.12)], but not infant PNC or child immunization.
Interpretation: Higher district availability of women physicians is associated with higher maternal health care utilization but not child health care utilization. Improving gender parity in the physician workforce and rural women physician access may improve maternal health care use in India.

1. Introduction

Access to doctors and other health providers in rural, remote and poorer areas is a global concern [1–9]. However, physician maldistributions disproportionately impact primary health care in low- and middle-income countries (LMICs) such as India that are striving to achieve global development targets [1,4,5,7,10–13]. Deficits in physician availability have hindered Indian states' progress toward achieving universal health coverage and reproductive, maternal and child health (RMCH) targets. Issues of availability of women physicians in rural settings in particular need urgent attention. Workforce audits show glaring regional, rural-urban and socioeconomic imbalances in doctor-patient ratios but neglect the intersectionality with gender inequities in the health system that can influence the implementation of RMCH programs across states [13]. Globally, there is also growing concern regarding the challenges faced by women healthcare providers, be it physicians, nurses or community health workers,

Abbreviations. AHS, Annual Health Survey; ANC, antenatal care; ANM, Auxiliary Nurse Midwife; BCG, bacillus Calmette Guerin; DHS, Demographic and Health Surveys; DLHS, District level Household and Facility Survey; DPT, diphtheria pertussis and tetanus; HIC, high income countries; HMIS, Health Management Information System; IIPS, International Institute for Population Sciences; ILO, International Labor Organization; IPHS, Indian Public Health Standards; LHV, lady health visitor; LMIC, low-and-middle income countries; LMO, Lady Medical Officer; MoHFW, Ministry of Health & Family Welfare; NFHS, National Family Health Survey; NHM, National Health Mission; NHRM, National Rural Health Mission; NUHM, National Urban Health Mission; OLS, ordinary least squares; PHC, Primary Health Center; PNC, postnatal care; RMCH, reproductive, maternal and child health

* Corresponding author.
E-mail addresses: nabhan@ucsd.edu , nandita.gehindia@gmail.com (N. Bhan), lmcdouga@ucsd.edu (L. McDougal), yamini.atmavilas@gatesfoundation.org (Y. Atmavilas), anitaraj@ucsd.edu (A. Raj).

https://doi.org/10.1016/j.eclinm.2020.100309

Research in context

Evidence before this study

Post the National Rural Health Mission (NRHM) in India, there has been an emphasis on increasing the number and strengthening the role of women community health workers along with addressing systemic and social barriers to their service delivery. In contrast, the value of increasing access to women physicians and challenges to their work are less understood. In many contexts, there may be a preference for gender-matched providers, particularly in more traditional contexts such as rural India where women's health seeking remains low.

Even as global literature suggests that women feel greater comfort discussing ailments of an intimate nature with a woman doctor, the association of women physician availability with maternal and child health care utilization has not been systematically examined in India. Increasing access to women physicians may be a particularly difficult challenge given the overall lower availability of physicians as well as of women physicians in rural contexts. The Indian government, recognizing the importance of women physician access, has designated slots for a Lady Medical Officer (LMO, i.e., a woman physician) at each of its Primary Health Centers serving rural India. Using triangulated data from two nationally representative surveys from India, we examined whether women physician (i.e., LMOs at PHCs) availability was associated with maternal and child health service utilization at the district level, adjusted for markers of socioeconomic status.

Added value of this study

Geographic and socioeconomic inequities in access to doctors occupy the health workforce discourse, but greater recognition is needed for the intersectionalities with gender. This is among the first studies in India that provides evidence for the value of women physician availability in improving health care utilization outcomes. Gender gaps in doctor availability and subsequently the challenges faced by women physicians working in low resource settings need systematic recognition as calls for more representation of women across the healthcare system and through training to recruitment and work are being made. Data available show that most districts have high vacancies for designated women physicians (i.e., >50% of PHCs in a district without an LMO). However, districts where the majority of PHCs had LMOs also reported higher levels of maternal health coverage, including modern contraceptive use, antenatal care, skilled birth attendance, and a maternal postnatal care (PNC) visit. LMO availability was not associated with district level coverage of PNC infant care or childhood vaccinations. Findings accounted for indicators of district level wealth, infrastructure, health insurance coverage and urbanicity. Further research is needed to help explain the mechanisms of the observed association findings.

Implications of all the available evidence

Ensuring the supply and retention of health staff is key to a well-functioning system. Our findings make the case that having more women doctors in place is associated with greater utilization of maternal health services in rural India, thereby improving reproductive and maternal healthcare indicators. Present interventions for incentivizing health providers to serve in rural and remote settings have shown mixed findings. Evidence from findings on the constraints faced by doctors show a range of structural barriers that may lead to lower preferences for serving in rural settings. But given the findings for improved maternal utilization indicators, there is a need for greater efforts to prioritize availability of women physicians in rural India.

in the delivery of their professional duties. These challenges include discriminatory behavior in recruitment, lower pay, lack of authority and threats of violence, leading to lower intake and higher dropping out of service among women [7,13–15]. Recent cross-national analyses have also highlighted the devaluation faced by women in the health system through gender inequitable norms around prestige, salary and opportunities for advancement [16].

Health systems across LMICs face shortages of women doctors and health staff in rural settings, which are often considered challenging or remote posts. Rural postings are also associated with more inequitable gender norms, lower value to women's educational and work status and harder access to public infrastructure [17]. Medical training schools are often located in urban centers and women doctors report balancing of work with domestic responsibilities as reasons for their unwillingness to be stationed in far-off rural locations [18,19]. To counter physician shortages more broadly, the National Health Mission (NHM, previously National Rural Health Mission (NRHM)) in India adopted approaches such as contractual hiring, incentives for physicians to serve in remote areas and for states to increase staffing and medical education policies for increasing underrepresented groups [20]. Despite these efforts, not enough doctors, particularly women doctors are available in primary care systems. Recommendations by the Indian Public Health Standards (IPHS)[1] to improve health service access, specifically aimed at increasing health seeking among rural women comprise the mandatory inclusion of one woman doctor (officially referred to as a *Lady Medical Officer* (LMO)[2]) [21–24] per three physicians at each primary health center (PHC) [21,25,26]. In India, we are aware of no studies that have examined relationships between physician gender and health service use, even as empirical evidence from other contexts shows some differences in preventive care and health screening based on physician gender but not for curative services [27–29].

Our goal was to improve the understanding of whether access to women doctors can improve health service uptake in the Indian context. To this end, we examined the association between women physician availability and RMCH indicators in India, adjusted for urbanicity, socioeconomic status and women's higher education using data from two national surveys.

2. Methods

2.1. Study design

We analyzed cross-sectional data from the National Family Health Survey (NFHS) 2015–16 [30] and the District level Household and Facility Survey (DLHS) 2012–13 [31]. The National Family Health Surveys (NFHS) are part of the global Demographic and Health Surveys (DHS), conducted by the IIPS (Mumbai), with support from the Ministry of Health and Family Welfare (MoHFW), Government of India and ICF International Inc [30]. These surveys provide an opportunity to understand determinants of reproductive, maternal and child health

[1] As per the recommendations of the Indian Public Health Standards, each primary health center (PHC) is to be staffed by a medical officer with recommendation of 2 additional medical officers, one of which will be female. The medical officer is responsible in her/his individual capacity and overall in-charge. She/he will be solely responsible for the proper functioning of the PHC, and activities related to national health programs. Responsibilities include *curative work* (including attending to cases and making arrangements for work distribution), preventive and promotion work (developing operational plans and effective implementation of national health programs), training of staff and administrative activities like maintaining records and logistics at the facility.

[2] The nomenclature of LMO refers to women doctors in their professional position in public health systems in India, even as it is increasingly waning in use and is considered antiquated. The origins of this nomenclature can be traced to historical accounts referring to segregated health services for women in pre-independence India, establishment of the Association of Medical Women in India and the first medical college allowing women in 1875.

in India. DLHS is a periodic survey that collects data on the Reproductive and Child Health program in India, conducted by the International Institute for Population Sciences (IIPS) and the MoHFW, Government of India [31]. In this study, we used DLHS-4 data [32] from 18 states where facility assessment was conducted. DLHS −4 states included Andhra Pradesh, Arunachal Pradesh, Goa, Haryana, Himachal, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Punjab, Sikkim, Tamil Nadu, Telangana, Tripura and West Bengal that had not participated in Government of India's Annual Health Surveys (AHS).

The final study sample of this study included all 256 districts (n = 256) in 18 states. Both these datasets were available open-access and accessed through the websites of the National Rural Health Mission [33] and the IIPS respectively. We utilized district factsheets using indicators for RMCH outcomes and measures of physician and health worker availability in primary care derived by the IIPS and Government of India. Derived indicators were based on appropriate sample weights, with strategies devised for minimizing non-sampling error and for data quality; details can be obtained from study reports.

While India's health system is multi-layered, our measures and analyses focused on districts, and inferences are limited to district and state levels only. Women doctors are deputed as medical officers in primary health centers (PHCs) focused on rural populations, even as in recent years, PHCs have been introduced in urban settings per the National Urban Health Mission (NUHM, 2014) under the joint National Health Mission [34]. Each PHC comprises 4−6 sub-centers that are run by health workers and form the point of contact and referral between the community and the health system. For robustness, we conducted sensitivity analyses on rural populations and adjusted for urbanicity as a covariate, even as no differences were expected in overall versus rural estimates.

2.2. Measures

2.2.1. Dependent variables

We used a *continuum of care* approach examining six key indicators (or measures) of RMCH (measured as district percent) through pre-conception to post-delivery child care [35]. These indicators are central to India's health programs as well as have significance for achieving global health goals. These include *modern contraceptive use* (indicator: any modern method of family planning among currently married women ages 15−49 years (%)), 4 + *antenatal care (ANC) visits* (indicator: mothers who had at least 4 ANC visits (%)for last birth in the five years before the survey) [36], *skilled birth attendance* (indicator: births assisted by a doctor/nurse/lady health visitor (LHV)/auxiliary nurse midwife (ANM)/other health personnel (%) for all births in the last five years before the survey), *postnatal care (PNC) for the mother* (indicator: mothers who received PNC from a doctor/nurse/LHV/ANM/midwife /other health personnel within 2 days of delivery (%)), *child immunization* (indicator: children age 12−23 months fully immunized (Bacillus Calmette Guerin (BCG), measles and 3 doses each of polio and Diphtheria Pertussis and Tetanus (DPT) (%) vaccines), and *postnatal care for the child* (indicator: children who received a health check after birth from a doctor/nurse/LHV/ANM/midwife/other health personnel within 2 days of birth for last birth in the 5 years before the survey (%)). These RMCH indicators represent a breadth of services being delivered by a PHC, in rural settings, and the functions of the medical officer (man or woman) includes RMCH service delivery and monitoring/supervision of standards.

2.2.2. Independent variables

Our independent variable of interest was the district *percent (%) of PHCs having a lady medical officer (LMO)* as available in the DLHS 4. We used this measure as a continuous variable in the main analysis. For bivariate analyses including t-tests for mean differences in outcomes and chi-square tests for differences between districts below and above median values of the health indicators, we categorized LMO availability as binary comparing districts with less than 50% of PHCs having LMOs (reference) versus with districts with PHCs having more than or equal to 50%. Districts with more than half the PHCs having an in-place LMO may be indicative of a more supportive district environment for women physicians.

2.2.3. Covariates

We adjusted for six district-level covariates. These included three covariates from the NFHS data including *percent of households with an improved drinking-water source* (%), *percent of households with any usual member covered by a health scheme or health insurance* (%) and *percent of women with 10 or more years of schooling* (%) in the district. These represented diverse markers of district socioeconomic status (water source and health scheme coverage) and of the status of women (women's higher education). Additionally, from the DLHS data, we used and adjusted for *availability of male health worker at the sub-center (%)*, which represents a cadre of health worker delivering basic health and family planning services and the *sampled number of PHCs in the district* to indicate district size. These were 15 on average (with interquartile range between 9 and 21). Finally we included *percent urban population* in the district as a covariate from district factsheets available from the NRHM − Health Management Information System (HMIS) website [33]. The measure of urbanicity may be a marker for better health systems or access to social and health services, and higher socioeconomic status of the district.

2.2.4. Analysis

We examined mean differences (along with t-tests) for all six outcomes − modern contraceptive use, 4+ ANC, skilled birth attendance, maternal PNC, infant PNC, and child immunization across districts with higher versus lower prevalence of PHC with LMOs (i.e., PHCs having LMOs < 50% versus districts with PHCs having LMOs >=50%; p-values reported). We also compared mean differences in key covariates by LMO distribution. We used multilevel regression models nesting districts in states to examine the association between LMO availability and the study outcomes, adjusted for drinking water access, health scheme coverage, percent of higher educated women, urbanicity, number of PHCs in the district and male health worker availability in the district. We compared multilevel models to ordinary least squares (OLS) regression models with robust standard errors and state fixed effects models for model specification, and multilevel models were preferred as they recognized the data structure of the surveys and provided more conservative confidence intervals. Additionally, we created binary measures of the outcomes classified by the number of districts below and above the median value of the measure, comparing against the binary measure of LMO. This was conducted as an exploratory analysis to examine whether districts with more than 50% of PHCs with LMO were significantly better than those less than 50% of PHCs with LMOs. Finally, for sensitivity analyses, we conducted primary multilevel analyses for rural populations only as PHCs and LMOs largely served rural areas until recently.

2.3. Funding

This study was supported by the Bill & Melinda Gates Foundation (Grant Number: OPP1179208), with one co-author affiliated to the funding agency making substantive contributions in her individual capacity as an expert on gender issues. The funding agency did not have any formal role in designing or drafting of this study and manuscript.

3. Results

Overall, more than one in four districts (28.1%) had more than half of their PHCs staffed with at least one lady medical officer in 2012−13. Mean differences across districts with 50%+ LMOs compared to less than 50% LMOs showed higher maternal and child health care utilization outcomes for the former, with higher 4+ antenatal care visits (72.4% vs

Table 1a
Mean differences (and *t*-test) for reproductive, maternal and child health (RMCH) indicators at the district level stratified by districts with Primary health Centers (PHCs) having lady medical officers (LMOs) >=50% versus <50% for the overall and rural populations in the National Family Health Survey (NFHS)-District level Household Survey (DLHS) sample of 256 districts in 18 states in India.

	Total Population				Rural Population			
	Overall mean	Districts with PHCs having LMO < 50% (*n* = 184)	Districts with PHCs having LMO > 50% (*n* = 72)	P	Overall Mean	Districts with PHCs having LMO < 50% (*n* = 182)	Districts with PHCs having LMO> 50% (*n* = 67)	*P*
Modern contraceptive use, any (%)	49.9 (47.7,52.2)	51.1 (48.6,53.7)	47.04 (42.4,51.7)	0.1	50.1 (47.6,52.5)	51.3 (48.6,54.1)	46.6 (41.4,51.8)	0.08
4+ antenatal care (ANC) visits (%)	65.6 (62.9,68.2)	62.9 (59.7,66.1)	72.4 (68.1,76.6)	**0.0015**	64.1 (61.2,66.9)	61.4 (57.9,64.9)	71.3 (66.4,76.1)	**0.002**
Skilled birth attendance (%)	85.1 (82.9,87.4)	82.5 (79.6,85.3)	91.9 (89.04,94.9)	**0.0002**	83.1 (80.6,85.7)	80.3 (77.1,83.4)	90.9 (87.4,94.4)	**0.0002**
Maternal Postnatal care (PNC) (%)	67.3 (64.7,69.8)	65.2 (62.1,68.3)	72.6 (68.7,76.6)	**0.008**	65.5 (62.8,68.2)	63.4 (60.0,66.7)	71.4 (67.0,75.8)	**0.009**
Full immunization of children 12−23 (%)	65.4 (63.1,67.8)	63.7 (60.9,66.5)	69.7 (65.3,74.1)	**0.02**	64.4 (61.4,67.3)	63.3 (59.8,66.7)	67.7 (61.7,73.6)	0.1
Infant Postnatal care (PNC) (%)	26.3 (24.4,28.1)	25.5 (23.3,27.6)	28.3 (24.5,32.1)	0.1	26.9 (24.9,28.9)	26.3 (23.9,28.6)	28.8 (24.6,32.9)	0.2

Bold for p-values < 0.05.

62.9%, p = 0.001), skilled birth attendance (91.9% vs 82.5%, p = 0.0002), postnatal care for women (72.6% vs 65.2%, p = 0.008) and full immunization of children 12−23 months old (69.7% vs 63.7%, p = 0.02), but not for modern contraceptive use and PNC for children (Table 1a). Sensitivity analyses comparing the same outcomes for rural populations only showed similar patterns for 4+ ANC visits (71.3% vs 61.4, p = 0.002), skilled birth attendance (90.9% vs 80.3%, p = 0.0002) and postnatal care for women (71.4% vs 63.4% p = 0.009). However, our findings do not show differences in family planning and PNC for children with LMO availability among rural populations (Table 1a). Mean differences for covariates by LMO availability were also noted for health scheme coverage (42.7% vs 33.6%, p = 0.004), higher education of women (48.4% vs 39.5%, p<0.001), urbanicity (38.1 vs. 26.2, p<0.001) and lower sub-center availability of male health workers (35.5 vs 46.7, p = 0.005) (Table 1b).

Multilevel regression models that assessed the adjusted associations between LMO availability and RMCH outcomes showed that LMO availability was associated with a 7% increase [β=0.07 (95% CI: 0.008,0.13)] in percent of 4+ ANC visits, along with increases in modern contraceptive use [β=0.04 (0.0078,0.08)], skilled birth attendance [β=0.088 (95% CI:0.03,0.14)] and in postnatal care for women [β=0.076 (95% CI: 0.03,0.12)] (Table 2). Between and within state variation estimates showed variability in antenatal care, skilled birth attendance and maternal postnatal care at the state level and infant postnatal care within states. LMO availability was not associated with child immunization or PNC for the child. Among the covariates, higher education of women was associated with ANC visits, skilled birth attendance, PNC for the mother and child, and child immunization but not associated with contraceptive use. Urbanicity and health coverage were not associated with the outcomes. Multivariable analyses among rural populations only showed adjusted associations between LMO availability with modern contraceptive use [β =0.049 (0.006, 0.9)], 4+ ANC visits [β =0.058 (0.002, 0.11)], skilled birth attendance [(β =0.09 (95% CI: 0.02, 0.15)] and postnatal care for the mother (β =0.07 (95% 0.02, 0.12), but not other outcomes (Supplementary Table 1).

Exploratory analyses comparing dichotomized LMO availability (more than 50% vs less than 50%) with outcomes below or above median value showed bivariate associations for 4+ANC visits (p<0.001) and skilled birth attendance (p<0.001) (Supplementary Table 2).

Table 1b
Mean differences (T-test) between district level factors by availability of lady medical officers (LMOs) for 256 districts in 18 states in India.

	Lady Medical Officer (LMO,%)		
	Districts with LMO < 50% (*n* = 184)	Districts with LMO >= 50% (*n* = 72)	*P*
Households with an improved drinking water source (%)	87.4 (85.7,89.2)	86.1 (81.8,90.5)	**0.5**
Households with any usual member covered by a health scheme or health insurance (%)	33.6 (30.4,36.9)	42.7 (36.9,48.6)	**0.004**
Women with 10 or more years of schooling (%)	39.5 (37.4,41.6)	48.4 (45.7,51.2)	<**0.001**
Percent urban population (%)	26.2 (23.9, 28.4)	38.1 (33.1,43.06)	<**0.001**
Sub-center with Male Health Worker (%)	46.7 (42.8,50.5)	35.5 (27.7,43.2)	**0.005**

Bold for p-values < 0.05.

4. Discussion

Findings from this study in India showed that districts with higher women physician availability in rural primary care reported higher reproductive and maternal health care utilization (e.g., modern contraceptive use, antenatal care, skilled birth attendance and maternal postnatal care). No significant associations were seen between women physician availability and child health care utilization. Estimates were adjusted for markers of district affluence - urbanicity, socioeconomic status of households and women's higher education, and for the number of PHCs in the district, for robustness. Findings from this study reiterate the need to understand gender-related influencers of health service uptake. Cross-contextual validation of the main finding from this study of the effects of women phyisician availability on women's own health seeking but not for child health indicators (infant PNC and child immunization) is needed. The latter may be attributed to prioritization of healthcare of children, where mothers or families are open to approaching doctors at primary care centers irrespective of their gender. Limited empirical evidence exists on this divergence in findings for women and children and further research using a gendered lens is needed to understand patient-provider interactions and preferences in India.

An alternate explanation for the observed findings as relates to maternal health may be that a PHC staffed with a woman doctor may be reflective of other district-level social indicators which simultaneously facilitate women physician employment and maternal health care utilization. These may include a more progressive social environment for women, higher safety and better infrastructure, or better schooling, childcare and other social services. Lack of individual level data on contextual, environmental and infrastructure variables impedes our ability to consider these factors. It may also be argued

Table 2
Multilevel models to assess associations between female medical officer availability in district primary health centers (PHCs) and their associations with modern contraceptive use, antenatal care (ANC), skilled birth assistance, maternal and infant postnatal care, and child immunization from 256 districts in 18 states.

Variables in%	Modern contraceptive use (any) β (CI)	4+ ANC visits β (CI)	Skilled birth attendance β (CI)	Maternal postnatal care β (CI)	Full immunization of children 12−23 months β (CI)	Infant postnatal care β (CI)
PHCs having Lady Medical Officer (LMO)	**0.045* (0.0078,0.08)**	**0.07* (0.0088,0.13)**	**0.088* (0.03,0.14)**	**0.076* (0.03,0.12)**	0.046 (−0.03,0.12)	0.02 (−0.02,0.07)
Covariates:						
Households with improved drinking water source	**0.25* (0.01,0.49)**	**0.19 (−0.0009,0.4)**	**0.15* (0.03,0.28)**	0.10 (−0.07,0.27)	0.16 (−0.09,0.42)	0.12 (−0.027,0.27)
Households with health scheme or health insurance	0.09 (−0.08,0.27)	0.12 (−0.02,0.26)	0.09 (−0.03,0.23)	0.01 (−0.13,0.17)	0.08 (−0.13,0.3)	−0.018 (−0.13,0.09)
Women with 10+ years of education	0.14 (−0.17,0.45)	**0.45* (0.23,0.68)**	**0.56* (0.32,0.8)**	**0.58* (0.44,0.72)**	**0.46* (0.12,0.79)**	**0.18* (0.07,0.29)**
Urban population	−0.05 (−0.19,0.08)	0.007 (−0.13,0.14)	−0.0057 (−0.1,0.09)	−0.002 (−0.1,0.1)	−0.07 (−0.26,0.12)	−0.019 (−0.12,0.09)
Sub-center with Male Health Worker	0.01 (−0.039,0.06)	0.013 (−0.11,0.14)	0.07 (−0.005,0.15)	0.04 (−0.04,0.12)	0.007 (−0.12,0.13)	0.023 (−0.018,0.06)
Number of PHCs sampled in the district	**0.34* (0.006,0.67)**	0.3 (−0.04,0.65)	**0.27* (0.07,0.46)**	**0.31* (0.06,0.56)**	0.12 (−0.39,0.6)	**0.25* (0.01,0.49)**
Sigma_u	10.85	15.38	9.95	11.94	13.5	6.82
Sigma_e	10.26	10.24	8.19	9.91	12.9	8.77
rho	0.528	0.692	0.595	0.592	0.524	0.376
Wald chi2 (p-value)	35.07 (<0.0001)	36.11(<0.0001)	45.8 (<0.0001)	292.1 (<0.0001)	29.58 (0.0001)	36.1 (<0.001)

Significant effects at $P < 0.05$ are noted in bold (*); models adjusted for robust standard errors.

that facilities with more women physicians may create an environment more tailored to women's needs, emphasizing the role of women doctors as role models and leaders in rural communities, and not only health providers. More research, qualitative and quantitative, is needed to explore these issues.

The mechanisms linking higher women physician availability to improved reproductive and maternal health utilization need exploration. Some evidence [27] is available through qualitative accounts in other contexts that reveal preferences for women doctors for reproductive and sexual health conditions that are considered of an intimate nature, sensitive or associated with shame or stigma [37]. Women may also prefer women physicians, believing them to be able to better understand and respond to their needs [37]. Dyadic studies have also shown greater patient satisfaction with communication among woman-woman doctor-patient dyads compared to male-male doctor-patient dyads. However, evidence on gender differences in physician styles in general show women doctors exhibiting a more open style of communication, emphasizing counseling in addition to curative services [28,38,39], showing more empathy and providing better care [40,41]. Preferences for woman doctors have also been attributed to gender-related perceptions around communication style and attitudes (e.g. such as concern with patient's emotions, making the patient feel secure and comfortable, and lack of a domineering manner) rather than technical competence [37,42]. In contexts with more restrictive gender norms and lower autonomy of women in mobility and health seeking, women doctors can play an enhanced role in primary health care systems. A primary health facility staffed or led by a woman doctor may be more accessible to women in the community it serves, increasing their comfort or ease in seeking consultation or treatment for a sexual, reproductive or a maternal health issue [43]. Prior research on these issues has not included work from South Asia, and this study adds to the literature on the value and importance of women doctors for health service use.

While this study focuses on issues of women physician availability in India, gender inequities faced by women doctors in health systems more broadly also need attention. Data on women students in medical schools have shown that in 2011 while almost 51% of women students gained entry into medical colleges in India, this reduced to one third at the postgraduate level with only 17% women allopathic doctors [10,22]. Our findings also demonstrate ongoing low availability of women doctors in rural areas and at PHCs. Less than 30% of districts reported that at least half of their PHCs were staffed with an LMO. Disaggregated data on the health workforce are limited; for instance, our findings are based on data on primary care from DLHS districts and estimates of women physician availability across India were last available from the Census in 2001 [13,44]. Additionally, we urgently need to improve our understanding of challenges faced by women doctors which may explain gender differences in doctor absenteeism [45], poor performance and low retention and gender differences in specialty or location preference [12]. Research from other contexts has shown that women in the medical profession have shown greater consideration for balancing work with other responsibilities while making specialty choices, leading to their over-representation in some specialties (pediatrics, dermatology, psychiatry) and under-representation in surgical branches (with the exception of obstetrics and gynecology) [46–48]. Gender wage gaps in the medical profession also need investigation [49], as a recent ILO report showed that women are paid 34% less than men in India [50–53]. Research among doctors in India has also indicated greater family pressures on women, with disproportionate burdens of home/family/care responsibilities along with the pressures of medical practice [52]. Risks of workplace violence and sexual harassment for women doctors in India are inadequately understood [54–56], with global evidence showing gender-related abuse faced by women doctors within training as well as practice [46]. One small study from Indian hospitals showed high rates of verbal harassment (41%), psychological harassment (45%), sexual gestures and exposure (15%) and unwanted touch (27%) among hospital staff, including women doctors [55]. Economic incentives to doctors to serve in underserved areas [57–60] have been considered without recognizing systemic and social challenges faced by women doctors. Interventions such as flexible hours, part-time work, childcare support, family leave protections, mentorship and training for career development have been effective in other contexts [15,61] but need systematic examination in India. The risk of basing policies and standards on tokenism or 'add women and stir' approaches [62] rather than transformational approaches needs reflection.

In our study, availability of male health workers, a cadre of salaried front-line workers providing outreach and health education, was not associated with any of our maternal and child health care utilization outcomes. This cadre of workers was created under Indian National Rural Health Program with the goal of supporting community care areas [20]. But positions have been difficult to fill and have

even declined in recent years [63]. Male health workers can be important for rural health outreach in low resource settings. However, their role needs greater defining as guidelines indicate their responsibilities to include delivery of disease control programs, epidemic management, first-aid emergencies, sanitation and control of lifestyle diseases along with logistics management at health centers and facilitating the work of ANMs in family welfare and related activities. Women seeking care may be less responsive to male health workers, diminishing their value for maternal and child health care and this cadre may be better suited to build health awareness among families, particularly engaging male patient populations in reproductive health and family planning, given indications of low and delayed health care utilization among men in India [63].

Study limitations include reliance on self-report measures and cross-sectional analyses that preclude assumptions of causality. While data on women physician availability from the DLHS predates data on RMCH indicators from the NFHS, we do not infer causality. Further, reliance on ecological data at the district level only allow us to make inferences at the district level; concerns of ecological fallacy (e.g. these associations may not be inferred for individuals) may apply. Vacancies in India's health staffing have remained a challenge. This analysis is based on data from 18 Indian states, and necessarily excluded states not sampled by the DLHS such as Bihar and Uttar Pradesh with low rates of health care utilization. Hence, findings may not be generalizable to India as a whole. Future national surveys inclusive of physician data may be able to provide greater insight into these issues at a national level. Finally, we focused our analysis on availability and are unable to provide insight into the technical expertise, experience, performance, motivation or qualitative characteristics of women physicians who were sampled in this study.

Even as less than one third of districts report more than half of PHCs having women doctors, availability of those doctors was associated with higher uptake of maternal health services in India. Interventions to improve development and availability of women physicians are urgently needed and can lead to improved maternal health seeking among rural women while at the same time building a stronger and more inclusive physician workforce.

Declaration of Competing Interest

This work was supported by a grant by the Bill & Melinda Gates Foundation. YA is employed by the Bill & Melinda Gates Foundation and contributed in individual her capacity as a global and national expert on gender inequalities. Views expressed are those of the authors and are not necessarily those of any institutions.

Funding

This work was supported by the Bill & Melinda Gates Foundation (Grant Number: OPP1179208).

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.eclinm.2020.100309.

References

[1] Hoyler M, et al. Shortage of doctors, shortage of data: a review of the global surgery, obstetrics, and anesthesia workforce literature. World J Surg 2014;38(2):269–80.
[2] Grobler L, Marais BJ, Mabunda S. Interventions for increasing the proportion of health professionals practising in rural and other underserved areas. Cochrane Database Syst Rev 2015;6 doi:10.1002/14651858.CD005314.pub3.
[3] WHO. Global strategy on human resources for health: workforce 2030. 2016.
[4] Anyangwe SC, Mtonga C. Inequities in the global health workforce: the greatest impediment to health in sub-Saharan Africa. Int J Environ Res Public Health 2007;4(2):93–100.
[5] Ahmed SM, et al. The health workforce crisis in Bangladesh: shortage, inappropriate skill-mix and inequitable distribution. Hum Resour Health 2011;9(1):3.
[6] Kanchanachitra C, et al. Human resources for health in southeast Asia: shortages, distributional challenges, and international trade in health services. Lancet 2011;377(9767):769–81.
[7] Lehmann U, Dieleman M, Martineau T. Staffing remote rural areas in middle-and low-income countries: a literature review of attraction and retention. BMC Health Serv Res 2008;8(1):19.
[8] Salsberg E, Grover A. Physician workforce shortages: implications and issues for academic health centers and policymakers. Acad Med 2006;81(9):782–7.
[9] Wilson N, et al. Inequitable distribution of healthcare professionals to rural and remote areas. Rural Remote Health 2009;9(1060).
[10] Rao M, et al. Human resources for health in india. Lancet 2011;377(9765):587–98.
[11] Awofeso N. Improving health workforce recruitment and retention in rural and remote regions of Nigeria. Rural Remote Health 2010;10(1):1319.
[12] Dussault G, Franceschini MC. Not enough there, too many here: understanding geographical imbalances in the distribution of the health workforce. Hum Resour Health 2006;4(1):12.
[13] WHO. The health workforce in India. Human resources for health observer series no. 16. Sudhir Anand & Victoria Fan. Geneva, Switzerland: WHO; 2016. ([Accessed Jan 1, 2019: https://www.who.int/hrh/resources/16058health_workforce_India.pdf.
[14] Reichenbach L, Brown H. Gender and academic medicine: impacts on the health workforce. BMJ 2004;329(7469):792–5.
[15] Chen L, et al. Human resources for health: overcoming the crisis. Lancet 2004;364(9449):1984–90.
[16] Hay K, et al. Disrupting gender norms in health systems: making the case for change. Lancet 2019;393(10190): P2535−2549.
[17] Nallala S, et al. Why medical students do not like to join rural health service? An exploratory study in India. J Family Community Med 2015;22(2):111.
[18] Rao KD, Bhatnagar A, Berman P. So many, yet few: human resources for health in India. Hum Resour Health 2012;10(1):19.
[19] Nagarajan R. More women study medicine, but few practise the Times of India. News Story. 2016 Weblink: [Accessed on Jan 12, 2019 https://timesofindia.indiatimes.com/india/More-women-study-medicine-but-few-practise/articleshow/50525799.cms].
[20] GOI, National Health Mission. Health systems strengthening. Human resource; Weblink: [Accessed on Jan 12 https://nhm.gov.in/.
[21] Forbes G. Medical careers and health care for indian women: patterns of control. Womens Hist Rev 1994;3(4):515–30.
[22] Bhadra M. Indian women in medicine: an enquiry since 1880. Indian Anthropologist; 201117–43.
[23] Sehrawat S. Feminising empire: the association of medical women in India and the campaign to found a women's medical service. Soc Sci 2013;41(5/6):65–81.
[24] Anshu, Supe A. Evolution of medical education in India: the impact of colonialism. J Postgrad Med 2016;62(4):255–9.
[25] MOHFW, Indian Public Health Standards (IPHS) for Primary Health Centres. Guidelines. Directorate General of Health Services. Government of India; 2006. (Accessed on Jan 7, 2019. Weblink: http://www.iapsmgc.org/userfiles/4IPHS_-for_PHC.pdf).
[26] GOI, Indian Public Health Standards. Guidelines for Primary Health Centres. Revised 2012. Directorate General of Health Services, Ministry of Health & Family Welfare. Government of India; 2012 http://health.bih.nic.in/Docs/Guidelines/Guidelines-PHC-2012.pdf.
[27] Mast MS, Hall JA, Roter DL. Disentangling physician sex and physician communication style: their effects on patient satisfaction in a virtual medical visit. Patient Educ Couns 2007;68(1):16–22.
[28] Tabenkin H, et al. Differences in cardiovascular disease risk factor management in primary care by sex of physician and patient. Ann Fam Med 2010;8(1):25–32.
[29] Noori K, Weseley AJ. Beyond credentials: the effect of physician sex and specialty on how physicians are perceived. Curr Psychol 2011;30(3):275.
[30] IIPS, National Family Health Survey IV. District factsheets. Available on Website: http://rchiips.org/nfhs/nfhs4.shtml, 2015-16.
[31] IIPS, District level household & facility survey (Reproductive & Child Health project) [Internet]. Mumbai. [Internet]. Available from: www.rchiips.org [December 2018].
[32] Dandona R, Pandey A, Dandona L. A review of national health surveys in India. Bull World Health Org 2016;94(4):286.
[33] GOI, National Health Mission. Health Management Information System. Website: http://nhsrcindia.org/hmis-data-analysis.
[34] GOI, National Urban Health Mission. National Health Mission. Website: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=137.
[35] Kerber KJ, et al. Continuum of care for maternal, newborn, and child health: from slogan to service delivery. Lancet 2007;370(9595):1358–69.
[36] WHO, Antenatal care (at least 4 visits). Global Health Observatory (GHO) data. Website: https://www.who.int/gho/urban_health/services/antenatal_care/en/.
[37] Elstad JI. Women's priorities regarding physician behavior and their preference for a female physician. Women Health 1994;21(4):1–19.
[38] Roter DL, Hall JA, Aoki Y. Physician gender effects in medical communication: a meta-analytic review. JAMA 2002;288(6):756–64.
[39] Flocke SA, Gilchrist V. Physician and patient gender concordance and the delivery of comprehensive clinical preventive services. Med Care 2005:486–92.
[40] Tsugawa Y, et al. Comparison of hospital mortality and readmission rates for medicare patients treated by male vs female physicians. JAMA Intern Med 2017;177(2):206–13.
[41] Howick J, et al. How empathic is your healthcare practitioner? A systematic review and meta-analysis of patient surveys. BMC Med Educ 2017;17(1):136.

[42] Henderson JT, Weisman CS. Physician gender effects on preventive screening and counseling: an analysis of male and female patients' health care experiences. Med Care 2001:1281–92.
[43] Bang RA, et al. High prevalence of gynaecological diseases in rural Indian women. The lancet 1989;333(8629):85–8.
[44] WHO. The health workforce in India. Human resources for health observer series no. 16. Sudhir Anand & Victoria Fan. Geneva, Switzerland: WHO; 2016 https://www.who.int/hrh/resources/16058health_workforce_India.pdf.
[45] Chaudhury N, Hammer J. Ghost doctors: absenteeism in Bangladeshi health facilities. The World Bank; 2003. Vol. http://econ.worldbank.org/wdr/wdr2004/library/doc?id=29809.
[46] Sood M, Chadda RK. Women in medicine: a perspective. Indian J Gend Stud 2010;17(2):277–85.
[47] Allen I. Women doctors and their careers: what now? Bmj 2005;331(7516):569–72.
[48] Bickel J, et al. Increasing women's leadership in academic medicine: report of the AAMC Project Implementation Committee. Acad Med 2002;77(10):1043–61.
[49] Nair AG, et al. Work satisfaction, burnout and gender-based inequalities among ophthalmologists in India: a survey. Work 2017;56(2):221–8.
[50] Bhalla S, Kaur R. Labour force participation of women in India: some facts, some queries. 2011.
[51] ILO, India wage report. Wage policies for decent work and inclusive growth. ILO Decent Work Team for South Asia and Country Office for India, 2018. ILO. Accessed on [https://www.ilo.org/wcmsp5/groups/public/—asia/—ro-bangkok/—sro-new_delhi/documents/publication/wcms_638305.pdf].
[52] Saurabh K, et al. Personal and practice profile of male and female ophthalmologists in India. Indian J Ophthalmol 2015;63(6):482–6.
[53] Waghmare A. Gender wage gap highest in india, women are paid 34% less than men: ILO. Bus Standard 2018 Available online at https://www.business-standard.com/article/current-affairs/gender-wage-gap-highest-in-india-women-are-paid-30-less-than-men-ilo-118112701048_1.html.
[54] Subedi S, Hamal M, Kaphle HP. Sexual harassment in the hospital: are nurses safe. Int J Health Sci Res 2013;3(6):41–7.
[55] Chaudhuri P. Experiences of sexual harassment of women health workers in four hospitals in Kolkata, India. Reprod Health Matters 2007;15(30):221–9.
[56] Dasgupta J, et al. The safety of women health workers at the frontlines. Indian J Med Ethics 2017;2(3):209–13.
[57] Sheikh K, et al. Location and vocation: why some government doctors stay on in rural Chhattisgarh, India. Int Health 2012;4(3):192–9.
[58] Murthy S, et al. What do doctors want? incentives to increase rural recruitment and retention in India. BMC proceedings. BioMed Central; 2012.
[59] Padmanaban P, Raman PS, Mavalankar DV. Innovations and challenges in reducing maternal mortality in Tamil Nadu, India. J Health Popul Nutr 2009;27(2):202.
[60] Pallikadavath S, et al. Human resource inequalities at the base of India's public health care system. Health Place 2013;23:26–32.
[61] Standing H, Baume E. Equity, equal opportunities, gender and organisation performance. ITGPress; 2003.
[62] Harding S. Just add women and stir?, in missing links: gender equity in science and technology for development. Ottawa, ON, CA: IDRC; 1995.
[63] Bhandari, L. and S. Dutta, Health infrastructure in rural India. India infrastructure report, 2007: p. 265–71.