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Proximity to healthcare centres and service use: The case of Community Clinics in Bangladesh

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Abstract

We investigate how distance from healthcare centres affects service utilization for women and children. Relying on five rounds of recent nationally representative demographic and health survey data from Bangladesh, our logistic regression analyses reveal that proximity to healthcare centres barely affects the utilization of healthcare services for women and children, even in rural areas. Interestingly, this indicates that the government's preferred Community Clinics have not significantly contributed to the country's uptake of healthcare services. The low-service utilization may result from their poor standard at the local health centres indicating that improving the service quality can help Bangladesh raise the uptake of healthcare services.

KEYWORDS

Bangladesh, Community Clinics, health centre's proximity, healthcare service delivery

JEL CLASSIFICATION

I12, I18, H51

1 | INTRODUCTION

Bangladesh has progressed impressively on different health indicators in the last 2 decades compared to its neighbours and many other developing countries (Planning Commission, 2020a; Sachs et al., 2021). The government aims to continue with the pace and achieve the targets of Sustainable

Development Goals (SDGs) by the end of 2030. The success of the aim depends on the availability of healthcare service delivery centres (health centres hereafter) as they affect the utilization of their services (De Luca et al., 2021; Lindo et al., 2020; Lu & Slusky, 2019).

Previous studies find take-up of health services to be sensitive to distances to the health centres (Kremer & Glennerster, 2011). For example, Lindo et al. (2020) find substantial effects of travel distances on abortion rates. Lu and Slusky (2019) find driving distances to the nearest clinics to increase fertility rates. Thus, policies that reduce travel distances and travel times are likely to increase the utilization of health services (Karra et al., 2017). Abdallah et al. (2022), based on their analysis of the public healthcare services in Bangladesh, suggest that increasing the number of public health facilities would allow for greater access to health services for those living in remote areas and thus benefit them, particularly the poor.

The positive effects of the proximity to health centres on service utilization are likely to be higher in low-income settings where women and children with low socioeconomic backgrounds cannot access the services for infrastructural, religious, societal or financial constraints (McGuire et al., 2021; Raut & Tanaka, 2021). For example, McGuire et al. (2021) find distances to significantly reduce the probability of having a facility delivery in Malawi, which is particularly strong for women with lower socioeconomic status (SES). Even relatively small distances from health facilities are associated with substantial mortality penalties for children in low- and middle-income countries (Karra et al., 2017). Thus, finding out the optimal location of health centres can improve access and ensure the best possible health outcome for a country (Adhvaryu & Nyshadham, 2015).[1]

While improving access to the formal healthcare sector is a primary public health goal in many low-income countries, the returns to the access are unclear as the quality of care at public health facilities is often considered inadequate (Adhvaryu & Nyshadham, 2015). Previous studies report improved outcomes from improving the quality of service delivery (Arifeen et al., 2005; Chowdhury et al., 2008; Hoque et al., 2014). For example, Arifeen et al. (2005) find that the care quality of sick under-five children in first-level facilities in Bangladesh can improve their health outcomes. Chowdhury et al. (2008) find that appropriate training and supervision allow safe and effective management of severe pneumonia. Hoque et al. (2014) find that regular supervision of workers, even with minimal pre-service training, improves the quality of child healthcare in first-level health facilities. Thus, the quality of the offered and/or delivered services can affect health services utilization. In particular, high-quality services may attract many stakeholders to enjoy them, while people may take services from other sources or even avoid them when their perceptions of the service quality are poor.

The distance from healthcare facilities and their quality can be associated with each other. In particular, small facilities providing basic services and located in the proximity of rural households can suffer from the quality issue. For example, Dotse-Gborgbortsi et al. (2020) find that travel distance profoundly influences health facility births in Eastern Ghana. Furthermore, the quality of care increased the number of women giving birth in the health facilities. Elewonibi et al. (2020) find that, in North Eastern Tanzania, few women who received contraception from a health facility used their nearest facility, indicating their willingness to travel long distances for quality health facilities.

Against this background, we primarily investigate how the distance from the nearest health centre affects service utilization for women and children in Bangladesh. We also examine whether the service quality of some primary health centres, compared to the other types of health centres in the country, can be an issue. We choose to investigate the case of Bangladesh for two important reasons: first, the

[1]It is possible to increase access to some types of healthcare services through home delivery (Herrera-Almanza & Rosales-Rueda, 2020). However, it is difficult for many kinds of services like antenatal care and postnatal care.

availability of several rounds of large-scale demographic and health survey data that includes information on distances from different types of healthcare centres, and second, to investigate the contribution of the newly established/revitalized Community Clinics (CCs), on which the country relies heavily for the future delivery of healthcare services (Planning Commission, 2020a).

Analyzing five rounds of nationally representative Bangladesh Demographic and Health Survey (BDHS) data with the logistic regression technique, our investigation reveals that proximity to health centre marginally affects the utilization of health service delivery. As a result, the newly established CC in the country do not significantly contribute to increasing the utilization of healthcare services offered by them. This is also partly because a large majority of surveyed individuals are already living within reasonable proximity of health centres. We also investigate the case separately for rural and urban areas to examine whether the effects are higher in the former areas.

Our findings contribute to the literature on the effectiveness of some important healthcare service delivery in Bangladesh. While some previous studies examine the issue in different contexts, assumptions about model parameters may lead to different results for Bangladesh (Lomas et al., 2021). Our study may particularly contribute to the formulation/improvement of health policies in low-income settings by indicating that the proximity to potentially ill-managed/equipped health centres may not be enough to encourage the utilization of healthcare services. We also contribute by discussing policies that can assist in the uptake of key healthcare services in developing countries.

The remainder of this article is organized as follows. We briefly discuss the background of the Community Clinics in Bangladesh in Section 2. Section 3 presents the methodology and Section 4 briefly describes the data. Results from our analysis are presented in Section 5, and their policy implications are discussed in Section 6. Section 7 concludes.

2 | COMMUNITY CLINICS IN BANGLADESH

Public healthcare facilities in Bangladesh provide primary, secondary, and tertiary healthcare services. The country, for administrative purposes, is divided into eight divisions, 64 districts, 546 sub-districts, 4545 unions in rural areas, and 3215 wards in urban areas (DGHS, 2022a). In 2019, the country had 10 Postgraduate Institute & Hospitals, 26 Medical College Hospitals, 60 District/General Hospitals, 429 Upazila Health Complexes and 5245 Union health and family welfare centres and Union health centres/sub-centres. There are also 14,012 CCs located mostly in rural areas around the country (DGHS, 2022b; MoHFW, 2022).[2]

In 2017–2018, around 97% of the survey participants in urban areas had a health facility in their villages/mohallas or within 2 km of their location. Government facilities, including hospitals, upazila health complexes, family welfare centres, maternal and child welfare centres, and CC, were available within 2 km for 66% of participants. The remaining 31% of respondents had only non-government facilities within 2 km of the residences. The scenarios for rural areas were not very different. Around 94% of rural survey participants had a health facility in their villages/mohallas or within 2 km of their location. Government facilities were available within 2 km for 73% of participants. The remaining 21% of individuals had only non-government facilities within 2 km of the residence (NIPORT, 2020, Table 15.7). In reducing the distance from health centres, the CCs play a vital role in rural areas where a much lower proportion of people live in the proximity of a health facility of any type.

[2]In addition, urban primary care services are provided by the Ministry of Local Government, Rural Development and Cooperatives. The quality of services at these facilities is quite low, and in many cases, an individual's first point of contact is secondary and tertiary facilities. The NGOs and for-profit private sector provide primary care in their health centres and hospitals, such as satellite clinics and static centres (WHO, 2015).

The government aims to achieve health-related SDGs by strengthening the Community Based healthcare (CBHC) system. They thus identified CCs as the country's flagship program to extend primary healthcare at the doorsteps of the villagers. The CCs are assumed to take full responsibility for the health, population and nutrition of the entire community of its catchment area with one CC for every 6000 people in the country's rural areas (Planning Commission, 2020a, 2020b).[3]

CC were planned to be established in 1996 with the construction started in 1998. During 1998–2001, about 10,723 of them were established, of which about 8000 started functioning. The CCs were operational only for a short time as they were closed in 2001 after the change of the government and remained closed till 2008. The government planned to revitalize the CCs in 2009. Since then, around 14,012 facilities have been constructed with 4000 more clinics to be built by the end of 2022 (MoHFW, 2022; Planning Commission, 2020b).

The major services that the CCs aim to provide are (i) maternal and neonatal healthcare services, including services related to reproductive health and family planning, immunization, acute respiratory infection and diarrhoeal diseases; (ii) integrated management of childhood illness, including nutritional education and micronutrient supplements; (iii) screening and referrals for noncommunicable diseases, such as hypertension, diabetes, arsenicosis, cancer, heart disease and autism; (iv) treatment of minor ailments and first aid for simple injuries; (v) health and family planning education and counselling and identification of emergency and complicated cases with referrals and (vi) free of cost essential medicines. The CCs provide a woman-friendly platform where about 95% of service seekers are women and children availing various primary healthcare services locally (Planning Commission, 2020b). The government aims to ensure adequate staffing of the CCs with a proper supervision mechanism to effectively deliver their services (Planning Commission, 2020a).

3 | EMPIRICAL STRATEGY

We have employed the following specification to model an individual's likelihood of the utilization of a particular healthcare service:

$$y_i = \alpha + \beta\ D_i + \gamma \boldsymbol{X}_i + \lambda_s + \eta_t + \varepsilon_i, \tag{1}$$

where, for each individual i, the outcome variable y takes the value of one if someone has taken a particular healthcare service and zero otherwise. We use separate regressions to model the utilization of three crucial healthcare services for reproductive-age women—(i) use of modern birth control instruments, (ii) making four or more ANC visits and (iii) checking up by a trained provider within 42 days of delivery. We also use separate regressions for the utilization of three services by the children—(i) having all vaccines (for children aged 12–23 months), (ii) receiving vitamin A in the last 6 months (for children aged 9–59 months) and (iii) taking advice or treatment for fever symptoms (for under-five children). The reason for choosing these dependent variables is that they are important health indicators and CC (and some urban healthcare centres) provide services to women and children in those areas.

The exposure variable D is a dummy variable indicating whether the distance from an individual's residential area to the nearest healthcare centre is over 2 km. The coefficient of interest β is expected to be negative to reflect the reduced likelihood of the service utilization for women/children living over 2 km. We chose the distance dummy for our study due to its straightforward policy implications. The

[3]Although the CCs did not start their operation at a single point, we find no official criteria either to prioritize communities/villages to establish CCs or their location within each selected community.

distance dummy is also assumed to better handle the nonlinearities in the effect of distances on the health service intake.[4] Nonetheless, we have investigated the consequence of using different forms of distances in the model to confirm that our results are not dependent on the choice of distance cutoff. We have also considered different distance cutoffs and measures and discussed the consequences in Section 5.

The vector $\boldsymbol{X}$ includes a series of dummy variables that are likely to be important in determining health service utilization for women and children, although differently for different types of services (Akter et al., 2015; Anwar et al., 2015; Di Novi & Thakare, 2020). The analysis for women includes a person's age, education, partner's education, socio-economic status, and rural/urban location of residence. For our investigation with children, the vector $\boldsymbol{X}$ additionally includes the sex of the child and the child's age. Note that women's age and education and partner's education, used in the analysis for women, are replaced by the same categories for mother and father.

The term λ, division fixed effects, accounts for possible omitted location variables and the time-invariant differences in administrative divisions affecting service utilization. We also include η, survey rounds fixed effects, to capture the changes in the service delivery over the years. Finally, ε is the independently and identically distributed error term.

3.1 | Endogeneity issue

The problem with the above models is that the exposure variable 'distance from the nearest health centre' may suffer from endogeneity. The potential source of endogeneity in our model may engender from a couple of sources. First, the distribution of healthcare centres is non-random. It can be the case that the government has established health centres in locations with higher demand for its services. Second is residential sorting, in which high-service user households may relocate near the health centres to enjoy the benefit of healthcare services permanently.[5] Third, greater employment opportunities near the healthcare centres may attract young people with a higher demand for some healthcare services. For example, they can take birth control measures in a higher proportion as they may have less desire to have children. All factors are likely to be negatively associated with distance from health centres, thus making the exposure variable endogenous to the models for healthcare services. Not controlling for those factors in the empirical models will likely overestimate the average effect of distance on health service utilization.

Endogeneity in empirical models is typically addressed by employing the instrumental variable (IV) approach. Unfortunately, an important limitation of IV estimation is that it estimates the local average treatment effect (LATE) rather than the average treatment effect (ATE), a more policy-relevant quantity. In other words, the estimated impacts of treatments through the IV approach do not usually represent the case for the entire population, nor even for all treated observations. Instead, the IV estimate provides the treatment effect only for the people whose choice of treatment was affected by the instrument. Thus, the estimated treatment effects may vary with the choice of the instruments.

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[4]The use of the distance cutoff is motivated by the fact that the parliamentary committee for education in Bangladesh has suggested making primary schools available within 2 km of students' residences (Bdnews24.com, 2021). The same is likely to be appropriate for the healthcare centres in the country.

[5]Healthier and wealthier families may live closer to the healthcare centres, which are likely to be located in places with better infrastructure and educational facilities. Note that, in this case, not including health status in the model will inflate the impact of the distance from the nearest healthcare centre on the intake of healthcare services. On the other hand, household wealth is already included in the models and thus will not bias the estimates.

On the other hand, the discussed sources of endogeneity in our models are less likely to be an issue in the context of Bangladesh. The low concern for endogeneity is because, first, the health centres in the country are likely to be established with the consideration of equitable distributions across administrative regions rather than the demand for health services (Planning Commission, 2020a). Second, individuals are less likely to relocate near the health centres since the marginal cost of relocation can be higher than the transportation (and time) cost of visiting the health centres occasionally. Finally, the employment opportunities created by the healthcare centres, especially when they are small, are likely to be trivial to attract the young people with a higher demand for healthcare services.

Therefore, we mainly relied on the OLS technique, and recognizing the endogeneity concern, we interpret the coefficients of the exposure variable as the upper bounds of the ATE of proximity to healthcare centres. However, we used an IV approach as a robustness check. In that, we employed distance from the nearest madrasa (religious school), primary school, boy's high school, girl's high school, general (coeducation) high school, post office and cinema hall as instruments.

We believe that the considered variables are valid instruments in our models. The instruments are unlikely to be in the estimating model (1) for healthcare service intake. Furthermore, they are likely to be strongly correlated with the endogenous variable ‘distance from the nearest healthcare centre’ as amenities usually cluster. We combined those instruments with the heteroscedasticity-based instrument suggested in Lewbel (2012, 2018). In our case, the approach implies that the error term's variance increases with the distance from the nearest health facility, which is also likely as diverse options for the specific service intake will be available for the distant clients.[6]

4 | DATA

We analyze five rounds of BDHS data—2004, 2007, 2011, 2014, and 2017. The BDHS is a cross-sectional survey collecting nationally representative demographic and health information every 3 to 4 years. Participants of these surveys are recruited via a two-stage stratified sample design. In the first stage, enumeration areas (sample clusters) are selected from the sampling frame, and in the second stage, a systematic sample of 30 households is selected from each cluster. Self-reported information is collected through separate questionnaires for families, women, and men. The community questionnaires were administered in each selected cluster during the listing and collected information about the community's availability and accessibility of health services. Details of the various rounds of BDHS can be obtained from the published survey reports (NIPORT, 2005, 2009, 2013, 2016, 2020).

The BDHS selects married women of reproductive age (15–49 years) that include 11,440, 10,996, 17,842, 17,863 and 20,127 participants for 2004, 2007, 2011, 2014, and 2017 survey rounds, respectively. From the 78,268 surveyed women, we dropped 2891 widowed, 1013 divorced, and 1236 separated women, leaving us with 73,128 observations. Finally, we dropped 88 participants with missing weights to get a total of 73,040 women. Thus, our analysis of women's birth control service utilization includes 11,440, 10,996, 17,749, 17,863, and 20,127 women for 2004, 2007, 2011, 2014, and 2017 rounds, respectively.

We follow similar restrictions for constructing samples for analyzing other health service delivery for women. For the case of (four or more) ANC visits, restricting our sample to mothers with less than 5 years of old children leaves us a total of 27,101 observations. From that, we drop 11 observations

[6]We previously employed an empirical strategy that relied on the opening and closing of the CCs in a difference-in-differences (DiD) setting with urban (rural) women/children constituting the control (treatment) group. Unfortunately, DiD estimates were insignificant in all outcomes, possibly due to the slow changes in the number of CCs.

with missing weights to get the final analysis sample of 27,090 women. For the analysis of the utilization of PNC service by a trained provider, we additionally drop 1161 mothers who either have not mentioned whether they have their health checked after hospital discharge (or home delivery) or fail to mention the type of service provider. Thus, our final sample for analyzing PNC service by a trained provider is 25,929 women.

Birth records data in the survey include a total of 201,576 children, of which 33,605, 30,527, 45,844, 43,772, and 47,828 belong to the 2004, 2007, 2011, 2014, and 2017 survey rounds, respectively. From that, we only retain 7223 last-born children aged 12–23 months to construct our analysis sample for child vaccination. On the other hand, for the analysis of vitamin A utilization in the last 6 months, we retain 26,406 last-born children aged 9–59 months. We then drop 963 observations for missing information about vitamin A utilization and two observations for missing weights. Thus, our analysis sample for vitamin A utilization includes 25,441 children. Finally, for the analysis of advice sought for fever, we retain 11,755 under-five children who have suffered from fever in the last 2 weeks of the survey. We drop four observations for missing weights to get our analysis sample of 11,751 children.[7]

The primary outcomes of interest are three different health service utilizations each for women and children. Here, the three binary outcomes for women are defined as follows: (i) uses birth control methods, which takes a value of one if anyone currently uses a modern method and zero otherwise; (ii) has made adequate ANC visits, which takes a value of one if anyone makes four or more ANC visits and zero otherwise; and (iii) has received PNC service, which takes a value of one if anyone receives PNC service from a trained provider within 42 days of delivery and zero otherwise.

The three important health services for children are defined as follows: (i) vaccination, in which children aged 12–23 months who have received all vaccines, takes a value of one and zero otherwise; (ii) vitamin A utilization, in which child (aged 9–59 months) who has received vitamin A in the last 6 months, takes a value of one and zero otherwise; and (iii) have sought referral for fever, in which under-five children with fever symptoms who have received advice or treatment takes a value of one and zero otherwise. These healthcare services are important indicators of the usefulness of health facilities to the catchment population, and therefore, we have employed them in our analysis.

Proximity to the nearest health facility is the primary variable of interest in the study. The BDHS collected data on the distance of a household's place of residence from different types of health centres like hospitals, thana health centres, union health & family welfare centres, maternal & child welfare centres, private clinics, NGO clinics, CC, rural dispensaries, and satellite clinics. Distances to those facilities were given in the dataset and were measured in kilometres (km) from the centre of each sample cluster.[8] From all the distance data, we created a variable providing the minimum distance among all types of health service delivery centres. Finally, we categorized the variable as dichotomous, taking a value of one when someone lives further than 2 km from any health centre and zero otherwise.[9] Table 1 presents year-wise summary statistics of the dependent variables, indicating significant differences in some indicators between people living within 2 km of healthcare centres against those living apart.

[7]The deceased children are included in our analysis sample. However, our conclusions remain unaffected when they are dropped from the analysis.

[8]To calculate the distances, the community part of the survey recorded the geographic coordinates and altitudes at the centre of each cluster using Garmin eTrex Legend H units. The distances, therefore, were the same for all interviewed women in a sample area (NIPORT, 2020).

[9]Note that the values of the distance variable were recorded as zero when the health centre was located in the village/mohalla. Therefore, we considered those as ‘within 2 km of health centre’ category.

TABLE 1 Trends in health service utilization of women and children, 2004–2017

Indicators	2004 (%)	2007 (%)	2011 (%)	2014 (%)	2017 (%)
a. Woman health-related service utilization					
Using modern birth control methods					
All	47.29	47.46	52.05	54.06	51.90
Distance < 2 km	47.27	47.47	52.11	54.01	51.77
Distance ≥ 2 km	47.84	47.36	48.83	54.77	54.31
Difference	−0.57	0.11	3.27	−0.75	−2.55
	(3.91)	(4.61)	(3.81)	(3.08)	(2.44)
N	10,553	10,146	16,616	16,830	18,895
At least four ANC visits					
All	15.93	20.63	23.87	31.22	47.01
Distance < 2 km	16.41	21.05	24.07	31.52	47.45
Distance ≥ 2 km	4.60	16.37	12.97	25.97	39.21
Difference	11.81***	4.68	11.11*	5.55	8.24**
	(2.01)	(4.57)	(5.90)	(5.63)	(3.87)
N	5363	4920	7307	4488	5012
Check-ups by the trained provider within 42 days of delivery					
All	17.98	22.48	31.89	40.09	53.52
Distance < 2 km	18.38	22.87	32.31	39.89	54.32
Distance ≥ 2 km	8.53	18.47	11.88	43.51	39.51
Difference	9.85***	4.40	20.43***	−3.62	14.81***
	(2.59)	(2.68)	(5.81)	(7.28)	(5.54)
N	5363	4904	6187	4466	5009
b. Child health-related service utilization					
Child aged 12–23 months had all vaccines					
All	68.95	79.08	83.89	80.90	85.69
Distance < 2 km	69.81	80.07	84.10	81.13	85.46
Distance ≥ 2 km	51.10	69.09	76.01	77.03	90.09
Difference	18.70	10.97**	8.09	4.11	−4.62
	(11.64)	(5.31)	(6.80)	(6.96)	(4.32)
N	1266	1157	1560	1584	1656
Child aged 9–59 months received vitamin A in last 6 months					
All	82.16	89.19	61.92	64.24	81.33
Distance < 2 km	82.45	89.69	61.96	64.78	81.36
Distance ≥ 2 km	75.74	83.88	59.85	55.21	80.79
Difference	6.70	5.81**	2.10	9.57*	0.57
	(9.10)	(2.58)	(8.53)	(5.44)	(3.54)
N	4100	3874	5856	5583	6028

TABLE 1 (Continued)

Indicators	2004 (%)	2007 (%)	2011 (%)	2014 (%)	2017 (%)
Advice or treatment sought for fever symptoms					
All	18.86	24.62	27.51	32.73	27.29
Distance < 2 km	18.91	24.64	27.49	32.65	27.51
Distance ≥ 2 km	17.70	24.41	28.41	34.34	23.67
Difference	1.21	0.23	−0.92	−1.69	3.84
	(5.83)	(5.00)	(5.48)	(4.39)	(3.17)
N	2143	1847	2739	2518	2504

Note: SEs are reported in parentheses.
$*p < 0.10$; $**p < 0.05$; $***p < 0.01$.

Based on the previous literature, we consider five potential confounding factors in the analyses. For the analysis of women's healthcare services, they are woman's age (seven age groups: 15–19, 20–24, 30–34, 35–39, 40–44, and 45–49 years with the 25–30 years group as the reference category), woman's education (primary, secondary, and higher with the uneducated women as the reference category), partner's education (primary, secondary, and higher with the uneducated partner as the reference category), socio-economic status (poorer, middle, richer, and richest with the poorest group as the reference category), rural (with the urban households as the reference category), administrative divisions (Barishal, Chattogram, Khulna, Rajshahi, Rangpur and Sylhet with Dhaka as the reference category), and time (2007, 2011, 2014, and 2017 waves with the 2004 wave as the reference category). For the analysis of children, we additionally include sex (female, with male as the reference category) and child's age (less than 12 months and 12–23 months, with the child aged 24 or more months as the reference category). Table 2 presents the number of observations in each category of the exposure and control variables employed to analyze the health service utilization of women and children in Bangladesh.

5 | RESULTS AND DISCUSSION

We estimate model (1) for each dependent variable considered in this study. With the binary nature of our dependent variables, we estimate both the linear probability models (LPMs) and the logistic regression models but prefer the latter.[10] Each of the independent variables takes the form of a dummy variable, and so the OLS estimates and the marginal effects (MEs) from the logit models indicate the percentage point (pp) changes in the probability of service utilization for a specific group compared to the reference group.

The LPM estimates in Column 1 of Table 3 indicate no significant effect of distance on the use of modern contraceptives.[11] This is not surprising as many birth control devices are widely available in the local shops in Bangladesh, as we observe in the latest BDHS survey (NIPORT, 2020). For all

[10]This is because logistic (and probit) regressions have two important advantages over OLS. They provide more realistic, non-constant marginal probabilities, and they predict probabilities within the plausible bound of [0–1].

[11]Unless mentioned otherwise, all the tests in this study have been conducted at the 5% significance level. The regressions account for survey weights, and standard errors are adjusted for within-cluster correlations.

TABLE 2 Variables employed to analyze the health service utilization of women and children, 2004–2017

Indicators	2004 (%)	2007 (%)	2011 (%)	2014 (%)	2017 (%)
a. Characteristics used to analyze health service utilization of women					
Proximity to health facility					
Distance < 2 km	11,043 (96.2)	10,158 (91.2)	17,470 (98.3)	17,069 (94.5)	19,006 (94.8)
Distance ≥ 2 km	397 (3.8)	838 (8.8)	279 (1.7)	794 (5.5)	1121 (5.2)
Age group					
15–19 years	1703 (15.3)	1348 (13.0)	1911 (11.1)	2023 (11.4)	1951 (10.2)
20–24 years	2202 (19.2)	2174 (19.8)	3456 (19.8)	3161 (18.0)	3514 (17.7)
25–29 years	2012 (17.6)	1935 (17.6)	3387 (19.1)	3343 (19.0)	3572 (17.8)
30–34 years	1783 (15.7)	1661 (15.1)	2690 (15.0)	3012 (17.1)	3462 (17.2)
35–39 years	1480 (12.7)	1596 (14.2)	2300 (12.7)	2340 (13.0)	2953 (14.3)
40–44 years	1185 (10.1)	1218 (11.0)	2157 (12.1)	2170 (11.7)	2329 (11.4)
45–49 years	1075 (9.3)	1064 (9.4)	1848 (10.3)	1814 (9.9)	2346 (11.4)
Schooling					
No education	4419 (41.2)	3528 (34.1)	4629 (27.7)	4206 (24.9)	3202 (16.6)
Primary	3381 (29.4)	3268 (29.7)	5296 (30.0)	5226 (29.2)	6340 (31.2)
Secondary	2949 (24.4)	3345 (30.4)	6359 (35.0)	6722 (37.4)	7764 (39.6)
Partner's schooling					
No education	4134 (38.7)	3608 (35.6)	5185 (31.1)	5065 (29.1)	5209 (25.9)
Primary	2903 (25.7)	2881 (26.3)	4792 (27.1)	4855 (27.3)	5923 (30.2)
Secondary	2947 (24.5)	2900 (25.9)	5140 (28.2)	5266 (29.8)	5579 (28.2)
Household wealth					
Poorest	2048 (19.9)	1775 (19.2)	3077 (18.3)	3251 (18.8)	3826 (18.6)
Poorer	2058 (20.0)	1995 (19.6)	3315 (19.6)	3360 (19.1)	3833 (19.7)
Middle	2147 (19.8)	2095 (19.9)	3403 (20.1)	3621 (19.9)	3883 (20.2)
Richer	2276 (20.2)	2201 (20.5)	3762 (20.6)	3769 (21.0)	4088 (20.8)
Richest	2911 (20.1)	2930 (20.7)	4192 (21.3)	3862 (21.1)	4497 (20.8)
Urban/rural					
Urban	3904 (22.6)	4151 (22.6)	6179 (26.0)	6167 (28.3)	7374 (28.5)
Rural	7536 (77.4)	6845 (77.4)	11,570 (74.0)	11,696 (71.7)	12,753 (71.5)
Division					
Barishal	1360 (6.3)	1438 (6.0)	2050 (5.6)	2142 (6.2)	2154 (5.6)
Chattogram	2069 (17.8)	1943 (18.4)	2864 (18.2)	2865 (18.5)	2905 (18.0)
Dhaka	2589 (31.2)	2340 (31.2)	3062 (32.3)	3093 (34.8)	2974 (25.5)
Khulna	1708 (12.2)	1711 (12.7)	2640 (12.0)	2581 (10.3)	2630 (11.6)
Rajshahi	2564 (26.2)	2080 (25.2)	2590 (14.9)	2512 (11.8)	2167 (7.7)
Rangpur	. (100.0)	. (100.0)	2457 (11.5)	2531 (11.5)	2576 (13.9)
Sylhet	1150 (6.3)	1484 (6.4)	2086 (5.4)	2139 (6.9)	2492 (11.8)
N	11,440	10,996	17,749	17,863	20,127

TABLE 2 (Continued)

Indicators	2004 (%)	2007 (%)	2011 (%)	2014 (%)	2017 (%)
b. Characteristics used to analyze health service utilization of children					
Proximity to health facility					
Distance < 2 km	5162 (96.0)	4522 (91.2)	7206 (98.2)	6524 (94.4)	7078 (94.8)
Distance ≥ 2 km	204 (4.0)	404 (8.8)	108 (1.8)	331 (5.6)	433 (5.2)
Mother's age group					
15–19 years	892 (17.2)	749 (16.3)	1022 (14.2)	1055 (15.6)	978 (13.6)
20–24 years	1736 (32.5)	1627 (33.6)	2543 (35.4)	2252 (32.7)	2497 (33.1)
25–29 years	1338 (24.6)	1250 (25.3)	1985 (27.2)	1879 (27.6)	2086 (27.8)
30–34 years	837 (15.4)	745 (14.3)	1076 (14.2)	1087 (16.1)	1294 (17.0)
35–39 years	389 (7.1)	394 (7.5)	470 (6.1)	445 (6.2)	512 (6.6)
40–44 years	126 (2.3)	139 (2.7)	182 (2.5)	106 (1.4)	123 (1.5)
45–49 years	48 (1.0)	22 (0.4)	36 (0.5)	31 (0.4)	21 (0.3)
Mother's schooling					
No education	1866 (36.9)	1271 (26.2)	1330 (19.2)	1040 (15.9)	523 (7.1)
Primary	1649 (30.3)	1507 (30.9)	2187 (30.2)	1871 (27.6)	2118 (28.1)
Secondary	1512 (27.4)	1742 (36.2)	3171 (43.1)	3189 (46.7)	3577 (49.0)
Father's schooling					
No education	1994 (39.5)	1588 (34.2)	1958 (28.5)	1694 (25.4)	1223 (16.2)
Primary	1433 (26.9)	1380 (28.2)	2120 (28.9)	2044 (29.8)	2453 (32.9)
Secondary	1335 (23.9)	1319 (26.3)	2191 (29.4)	2098 (30.9)	2398 (32.9)
Household wealth					
Poorest	1167 (24.0)	937 (21.8)	1522 (22.0)	1435 (21.3)	1599 (20.7)
Poorer	1017 (20.7)	988 (21.3)	1395 (20.0)	1295 (18.9)	1458 (19.6)
Middle	990 (19.5)	910 (19.0)	1408 (19.8)	1332 (19.6)	1357 (19.1)
Richer	989 (18.4)	943 (19.5)	1472 (19.7)	1412 (20.3)	1525 (20.7)
Richest	1203 (17.4)	1148 (18.4)	1517 (18.5)	1381 (19.8)	1572 (19.9)
Urban/rural					
Urban	1684 (20.7)	1748 (21.2)	2326 (23.4)	2215 (26.2)	2681 (28.2)
Rural	3682 (79.3)	3178 (78.8)	4988 (76.6)	4640 (73.8)	4830 (71.8)
Division					
Barishal	615 (6.1)	658 (6.4)	855 (5.8)	814 (5.9)	785 (5.6)
Chattogram	1109 (20.6)	980 (21.0)	1392 (21.6)	1284 (21.0)	1218 (20.3)
Dhaka	1192 (31.0)	1051 (31.7)	1226 (31.5)	1222 (35.6)	1151 (26.4)
Khulna	728 (11.2)	623 (10.3)	876 (9.7)	778 (7.9)	822 (9.6)
Rajshahi	1085 (23.7)	829 (22.8)	946 (13.6)	856 (10.5)	861 (8.1)
Rangpur	.(100.0)	.(100.0)	960 (10.9)	876 (10.2)	823 (12.1)
Sylhet	637 (7.4)	785 (7.8)	1059 (6.9)	1025 (9.0)	862 (10.8)

(Continues)

TABLE 2 (Continued)

Indicators	2004 (%)	2007 (%)	2011 (%)	2014 (%)	2017 (%)
Sex of child					
Male	2731 (51.0)	2515 (50.5)	3786 (51.7)	3576 (52.8)	3947 (52.7)
Female	2635 (49.0)	2411 (49.5)	3528 (48.3)	3279 (47.2)	3564 (47.3)
Child's age (month)					
<12	1320 (24.5)	1151 (23.2)	1690 (23.3)	1494 (22.1)	1755 (23.1)
12–23	1266 (23.8)	1157 (23.5)	1560 (21.1)	1584 (23.7)	1656 (22.1)
24–59	2780 (51.7)	2618 (53.2)	4064 (55.6)	3777 (54.2)	4100 (54.8)
N	5366	4926	7314	6855	7511

Note: Number of observations in each groups are reported. Proportions are reported in parentheses.

other control variables, we mostly observe significant effects that align with our expectations. For example, women's age demonstrates a quadratic relationship with the use of contraceptives, which remains lower at a young age and then increases until they reach 35–39 years and decrease after that. The pattern is generally expected as women's demand for contraceptives increases until they reach a certain age, which then falls as they reach the end of their reproductive age. Previous studies find that many women, believing that fertility declines from the mid-30s, stop using contraception once they reach 40 years of age (Allen et al., 2013).

Schooling generally increases contraceptive use. Better-educated women are likely to prefer smaller families and thus have a higher demand for contraceptives (Di Novi & Thakare, 2020). On the other hand, women with secondary or higher educated partners have a lower contraceptive use. The observed pattern of birth control measures can be due to the increased use of birth control devices for men, associated with their increase in education, as we observe in BDHS (NIPORT, 2020). Interestingly, fewer women in the topmost SES group use contraceptives compared to the bottom. Previous studies find a similar pattern as the national family planning programs usually target poor women (Vu et al., 2016).

There are regional variations in the use of contraceptives, and rural women use them to a lesser extent, as observed in earlier research (Di Novi & Thakare, 2020). Fewer women in two conservative regions in Bangladesh—Chittagong (Chottogram) and Sylhet divisions—use modern birth control measures compared to their counterparts in the Dhaka division; more women in the remaining four divisions use modern contraceptives. Finally, the use of modern birth control methods increased over the survey periods. The overtime increase in modern contraceptive use is likely due to the government's encouragement of family planning and the overall modernization of the country (UNDP, 2017). All these results are consistent with some previous studies. For example, Amin et al. (2010) find that mother's education, wealth index, and place of residence are closely associated with access to maternal and newborn healthcare services in Bangladesh.

The MEs from the logit model in Column 2 are comparable to the OLS estimates. Since this generally holds for our entire analysis, we will only consider the former to explain the utilization of other healthcare services.

Column 4 presents the results from the model of taking (at least four) ANC visits. The results indicate that the ANC service utilization is lower by 4.1 pp for the people living over 2 km of any healthcare centre compared to their counterparts living within 2 km of a centre. The negative effect of distance reflects the fact that pregnant women struggle to visit a distant health centre (Herrera-Almanza &

TABLE 3 Risk factors related to woman and child health

	Woman health						Child health					
	Contraceptive use		ANC intake		PNC intake		Vaccine intake		Vitamin A intake		Advice for fever	
	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Proximity to health facility												
Distance ≥ 2 km	0.015	0.016	−0.032	−0.041	−0.024*	−0.035*	−0.043	−0.038	−0.047**	−0.052**	0.013	0.013
	(0.015)	(0.016)	(0.020)	(0.027)	(0.014)	(0.021)	(0.031)	(0.025)	(0.023)	(0.023)	(0.021)	(0.022)
Age group/mother's age group												
15–19 years	−0.173***	−0.178***	0.002	0.003	0.018*	0.022*	−0.039**	−0.037**	−0.064***	−0.061***	0.000	0.000
	(0.008)	(0.009)	(0.010)	(0.011)	(0.009)	(0.011)	(0.016)	(0.015)	(0.012)	(0.012)	(0.015)	(0.015)
20–24 years	−0.069***	−0.071***	0.002	0.003	−0.003	−0.002	−0.015	−0.015	−0.022**	−0.022**	0.000	0.001
	(0.007)	(0.008)	(0.008)	(0.008)	(0.007)	(0.009)	(0.013)	(0.014)	(0.009)	(0.010)	(0.012)	(0.012)
30–34 years	0.026***	0.028***	−0.001	−0.001	−0.008	−0.010	0.004	0.004	0.007	0.008	−0.007	−0.006
	(0.007)	(0.008)	(0.010)	(0.012)	(0.009)	(0.012)	(0.019)	(0.019)	(0.010)	(0.011)	(0.014)	(0.014)
35–39 years	−0.000	−0.000	−0.013	−0.015	0.003	0.010	0.021	0.016	0.004	0.004	−0.049**	−0.054**
	(0.008)	(0.008)	(0.014)	(0.019)	(0.011)	(0.016)	(0.024)	(0.023)	(0.012)	(0.013)	(0.019)	(0.023)
40–44 years	−0.137***	−0.141***	−0.022	−0.046*	−0.021	−0.041	−0.041	−0.036	−0.019	−0.017	−0.058**	−0.079*
	(0.008)	(0.009)	(0.014)	(0.026)	(0.016)	(0.030)	(0.047)	(0.037)	(0.022)	(0.022)	(0.028)	(0.041)
45–49 years	−0.295***	−0.316***	−0.059**	−0.171**	−0.015	−0.039	−0.340**	−0.216**	−0.080*	−0.074**	−0.047	−0.064
	(0.009)	(0.011)	(0.026)	(0.087)	(0.036)	(0.076)	(0.137)	(0.091)	(0.041)	(0.036)	(0.058)	(0.081)
Schooling/mother's schooling												
Primary	0.013**	0.014**	0.036***	0.091***	0.018**	0.063***	0.069***	0.046***	0.025**	0.026**	0.008	0.015
	(0.006)	(0.007)	(0.007)	(0.012)	(0.008)	(0.013)	(0.020)	(0.015)	(0.013)	(0.012)	(0.014)	(0.017)
Secondary	0.022***	0.023***	0.121***	0.173***	0.117***	0.164***	0.134***	0.111***	0.061***	0.061***	0.033**	0.040**
	(0.007)	(0.008)	(0.009)	(0.012)	(0.010)	(0.014)	(0.020)	(0.017)	(0.013)	(0.013)	(0.017)	(0.019)

(Continues)

TABLE 3 (Continued)

	Woman health						Child health					
	Contraceptive use		ANC intake		PNC intake		Vaccine intake		Vitamin A intake		Advice for fever	
	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Higher	0.003	0.004	0.249***	0.262***	0.266***	0.313***	0.156***	0.161***	0.073***	0.078***	0.125***	0.113***
	(0.011)	(0.012)	(0.015)	(0.016)	(0.015)	(0.019)	(0.025)	(0.031)	(0.017)	(0.019)	(0.027)	(0.024)
Partner's/father's schooling												
Primary	−0.002	−0.002	0.012*	0.027***	0.006	0.018	0.052***	0.041***	0.022*	0.022*	0.010	0.013
	(0.006)	(0.006)	(0.007)	(0.010)	(0.008)	(0.012)	(0.018)	(0.015)	(0.012)	(0.011)	(0.013)	(0.015)
Secondary	−0.028***	−0.030***	0.057***	0.069***	0.060***	0.071***	0.037**	0.027*	0.024**	0.025**	0.042***	0.043***
	(0.007)	(0.007)	(0.010)	(0.012)	(0.009)	(0.012)	(0.018)	(0.016)	(0.011)	(0.010)	(0.015)	(0.016)
Higher	−0.023**	−0.024**	0.148***	0.136***	0.166***	0.175***	0.071***	0.087***	0.049***	0.053***	0.017	0.020
	(0.010)	(0.011)	(0.014)	(0.013)	(0.014)	(0.015)	(0.023)	(0.028)	(0.014)	(0.015)	(0.022)	(0.021)
Household wealth												
Poorer	0.004	0.004	0.006	0.017	0.031***	0.060***	0.055***	0.044***	0.008	0.007	0.013	0.018
	(0.008)	(0.008)	(0.007)	(0.012)	(0.008)	(0.014)	(0.019)	(0.016)	(0.010)	(0.010)	(0.012)	(0.016)
Middle	−0.006	−0.007	0.036***	0.060***	0.070***	0.112***	0.062***	0.050***	0.009	0.007	0.054***	0.064***
	(0.008)	(0.009)	(0.009)	(0.012)	(0.011)	(0.015)	(0.020)	(0.016)	(0.012)	(0.012)	(0.018)	(0.020)
Richer	−0.010	−0.011	0.084***	0.108***	0.148***	0.194***	0.072***	0.061***	0.008	0.008	0.081***	0.089***
	(0.008)	(0.009)	(0.011)	(0.013)	(0.012)	(0.015)	(0.020)	(0.019)	(0.012)	(0.012)	(0.016)	(0.017)
Richest	−0.025***	−0.026***	0.210***	0.206***	0.290***	0.330***	0.093***	0.088***	0.028**	0.030**	0.152***	0.147***
	(0.010)	(0.010)	(0.013)	(0.014)	(0.013)	(0.016)	(0.022)	(0.023)	(0.013)	(0.014)	(0.019)	(0.019)
Urban/rural												
Rural	−0.060***	−0.064***	−0.091***	−0.090***	−0.077***	−0.089***	0.009	0.009	0.003	0.004	−0.083***	−0.078***
	(0.006)	(0.007)	(0.010)	(0.009)	(0.009)	(0.010)	(0.013)	(0.013)	(0.012)	(0.012)	(0.014)	(0.012)

TABLE 3 (Continued)

	Woman health						Child health					
	Contraceptive use		ANC intake		PNC intake		Vaccine intake		Vitamin A intake		Advice for fever	
	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Division												
Barishal	0.010	0.010	−0.005	−0.003	0.004	0.009	0.003	0.002	0.037**	0.038**	0.032*	0.035*
	(0.011)	(0.011)	(0.013)	(0.015)	(0.012)	(0.016)	(0.021)	(0.020)	(0.017)	(0.017)	(0.019)	(0.020)
Chattogram	−0.070***	−0.073***	−0.049***	−0.054***	−0.008	−0.008	−0.022	−0.021	0.058***	0.060***	0.022	0.024
	(0.009)	(0.010)	(0.013)	(0.016)	(0.011)	(0.014)	(0.017)	(0.016)	(0.015)	(0.015)	(0.016)	(0.016)
Khulna	0.043***	0.046***	0.037***	0.042***	0.100***	0.120***	0.048***	0.055***	0.022	0.022	0.052***	0.054***
	(0.009)	(0.009)	(0.012)	(0.012)	(0.013)	(0.014)	(0.016)	(0.019)	(0.016)	(0.017)	(0.019)	(0.019)
Rajshahi	0.090***	0.095***	0.031**	0.039***	0.020*	0.027*	0.042**	0.040**	0.052***	0.053***	−0.010	−0.013
	(0.009)	(0.010)	(0.012)	(0.015)	(0.011)	(0.015)	(0.019)	(0.019)	(0.014)	(0.015)	(0.016)	(0.018)
Rangpur	0.080***	0.084***	0.111***	0.112***	0.048***	0.061***	0.066***	0.080***	0.021	0.023	0.040*	0.043**
	(0.011)	(0.012)	(0.020)	(0.019)	(0.016)	(0.018)	(0.019)	(0.025)	(0.021)	(0.019)	(0.022)	(0.022)
Sylhet	−0.071***	−0.075***	0.018	0.028*	0.011	0.023	−0.067***	−0.055***	0.047***	0.048***	0.054***	0.059***
	(0.012)	(0.013)	(0.013)	(0.015)	(0.014)	(0.018)	(0.022)	(0.017)	(0.018)	(0.018)	(0.020)	(0.020)
BDHS wave												
2007 wave	−0.001	−0.001	0.028**	0.042**	0.026**	0.045***	0.078***	0.062***	0.065***	0.102***	0.048***	0.057***
	(0.011)	(0.011)	(0.012)	(0.017)	(0.010)	(0.016)	(0.023)	(0.019)	(0.011)	(0.016)	(0.016)	(0.019)
2011 wave	0.045***	0.047***	0.032***	0.048***	0.097***	0.139***	0.107***	0.092***	−0.215***	−0.205***	0.072***	0.081***
	(0.009)	(0.010)	(0.010)	(0.014)	(0.010)	(0.014)	(0.021)	(0.018)	(0.015)	(0.014)	(0.015)	(0.018)
2014 wave	0.066***	0.070***	0.088***	0.108***	0.160***	0.210***	0.075***	0.058***	−0.191***	−0.186***	0.109***	0.116***
	(0.010)	(0.011)	(0.015)	(0.018)	(0.013)	(0.016)	(0.022)	(0.018)	(0.016)	(0.015)	(0.019)	(0.020)

(Continues)

TABLE 3 (Continued)

	Woman health						Child health					
	Contraceptive use		ANC intake		PNC intake		Vaccine intake		Vitamin A intake		Advice for fever	
	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2017 wave	0.050***	0.053***	0.218***	0.221***	0.265***	0.316***	0.103***	0.088***	−0.033***	−0.036**	0.040**	0.049***
	(0.010)	(0.010)	(0.013)	(0.014)	(0.012)	(0.015)	(0.021)	(0.019)	(0.012)	(0.014)	(0.016)	(0.018)
Sex of child												
Female							0.003	0.002	0.002	0.002	−0.039***	−0.040***
							(0.010)	(0.010)	(0.006)	(0.006)	(0.009)	(0.009)
Child's age (month)												
<12							0.000	0.000	−0.202***	−0.179***	0.057***	0.058***
							(.)	(.)	(0.015)	(0.013)	(0.013)	(0.013)
12–23							0.000	0.000	−0.024***	−0.026***	0.039***	0.040***
							(.)	(.)	(0.008)	(0.008)	(0.011)	(0.012)
Constant	0.588***		0.083***		0.045***		0.546***		0.770***		0.158***	
	(0.013)		(0.014)		(0.012)		(0.033)		(0.017)		(0.023)	
R^2	0.06		0.22		0.27		0.08		0.09		0.07	
Pseudo-R^2		0.04		0.20		0.23		0.07		0.07		0.06
N	73,040	73,040	27,090	27,090	25,929	25,929	7223	7223	25,441	25,441	11,751	11,751

Note: (1) Marginal effects from logit models are reported; SEs are reported in parentheses. Stata svyset command has been used to adjust for the implication of the survey designs, such as the sampling units and weights, on the estimates and their SEs. (2) The reference groups for the analysis of woman health service utilization are women living within 2 km of any health centres, belong to the lowest SES group, have no education both for herself and her partner, located in the urban areas and in Dhaka division, aged 25–29 years and surveyed in the 2004 round of BDHS. (3) The reference groups for the analysis of child health service utilization are boys older than 2 years, have uneducated parents, belong to the lowest SES group, live within 2 km from any health centres, in the urban areas and in Dhaka division, whose mother's age is 25–29 years and are surveyed during the 2004 round of BDHS.

Abbreviations: BDHS, Bangladesh Demographic and Health Survey; SES, socioeconomic status.

Rosales-Rueda, 2020; Lu & Slusky, 2019). Unfortunately, the effect is again neither practically large nor statistically significant.

Among other control variables, ANC service utilization drops with women's age but increases with their own and partner's education and SES. Higher age can be associated with higher birth orders that may reduce the need for antenatal care services. Akter et al. (2016) find women with more than one child utilizing ANC services to a lower extent due to their previous pregnancy experiences and time constraint resulting from an increased responsibility of child care. On the other hand, higher education and SES can increase the demand for the service among women (Di Novi & Thakare, 2020). Again, rural mothers take lower ANC services, and the utilization varies by administrative divisions, reflecting the difference in socio-cultural factors (Di Novi & Thakare, 2020). Finally, the ANC service utilization increases over time due to the increased awareness of maternal and child healthcare services in Bangladesh (Akter et al., 2018).

Next, we discuss the model of PNC service utilization from a trained provider within 42 days of delivery. Column 6 results indicate that the postnatal care service utilization for the mothers living over 2 km of any health centre is lower than their counterparts living within 2 km of the centre. In particular, the PNC service utilization is lower by 3.5 pp for the former than for the latter group, but the effect is not statistically significant. The results for all other control variables closely follow the analysis for the ANC utilization.

Our results in Column 8 indicate that the probability of having (all the required) vaccination is 3.8 pp lower for children living over 2 km of any health centre compared to their counterparts, but the effect is not statistically significant. MEs of other control variables indicate a lower vaccination for a child with older mothers who are usually unaware of the benefits of vaccination. As observed in Di Novi and Thakare (2020), vaccination increases with parental education and wealth, indicating the role of consciousness and capacity in immunization. Finally, we observe significant variations in the vaccination rates among children of different regions and birth years.

Results from the model of vitamin A utilization, presented in Column 10, indicate a statistically significant and negative impact of living further from the health centres. In particular, the results suggest that Vitamin A utilization is significantly lower by 5.2 pp for children living over 2 km from health centres compared to the reference group. For similar reasons, the effects of other control variables in the model closely follow the results for vaccination.

Finally, we estimate the model for taking advice for fever of under-five children. The probit model MEs in Column 12 indicate no significant impact of distance on asking for advice. As observed earlier, the utilization of the service is lower for older mothers but increases with the rise in parental education and wealth (Arifeen et al., 2008). The advice sought is infrequent in rural areas with variations across the administrative divisions. Similar to what is observed for other services, the utilization of advice for fever increases over time. It was lower for girls, which can be due to gender bias as Ismail et al. (2019) find that care-seeking rates for female neonates are lower than males across several South Asian countries. Finally, less frequent advice for older children can be a consequence of the reduced need for advice for fever.

Our previous analysis relies on the binary exposure variable indicating locating within 2 km of health centres. The reason for choosing the cutoff of 2 km is its relevance and straightforward policy implications (Bdnews24.com, 2021). To see whether our results are robust to the cutoff change, we choose different distance cutoffs for the exposure variable and repeat the previous analysis. MEs of the distance variables are presented in Figure 1. The figure indicates that all the service utilization generally decreases as the distance cutoff increases in line with our hypothesis. However, the changes are only marginal. The statistical significance only holds for vitamin A utilization for any distance cutoff over or equal to 1 km.

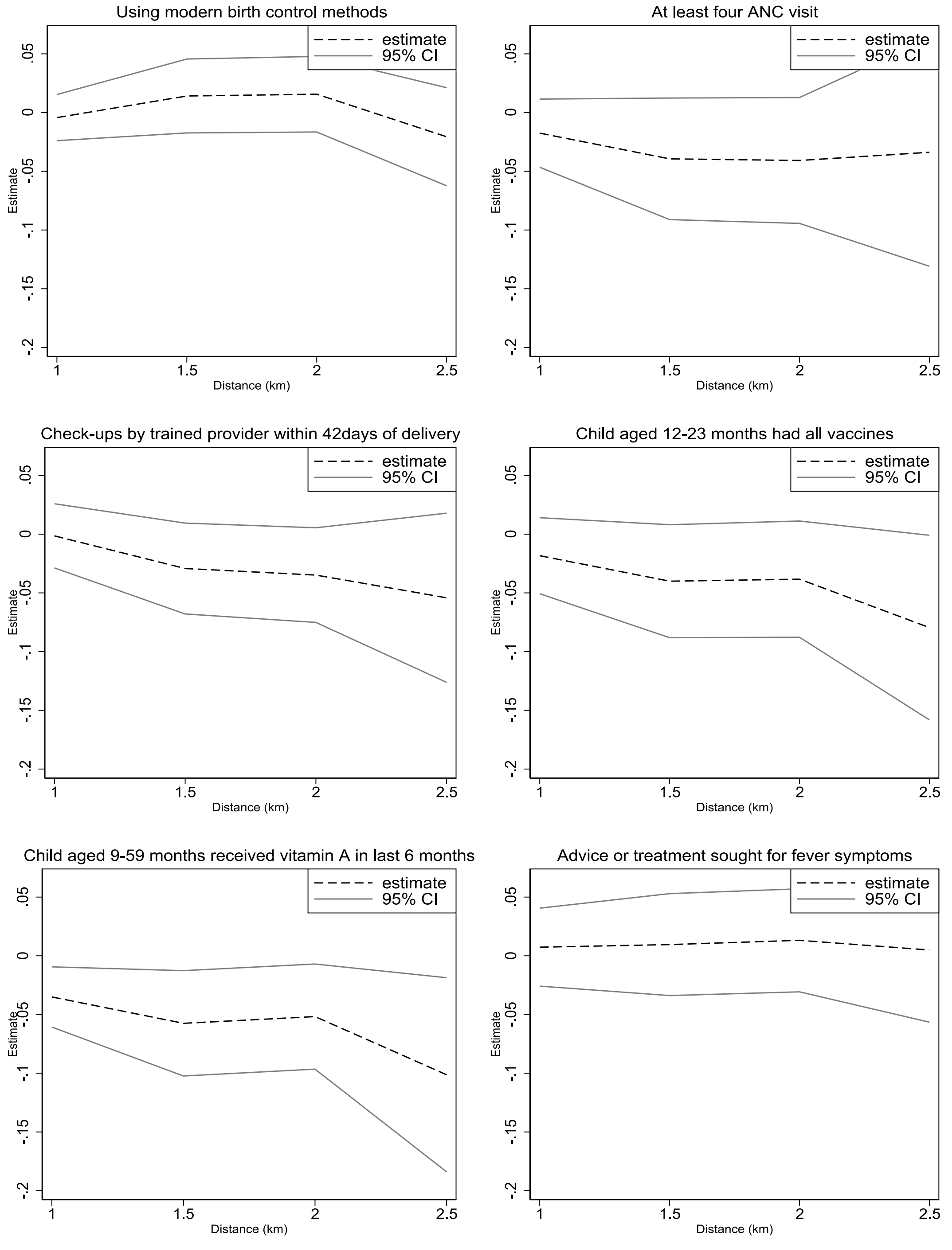

FIGURE 1 Effect of distances as cutoff changes

We have also tried using other forms of the exposure variable to see whether it affects our findings. For example, using (log of) distance from the nearest health centre (Table A1) provides a similar conclusion. An attempt to use a binary variable indicating whether there is a health centre in their own village/union also keeps our conclusion unaffected (Table A2). Using LPMs, like the case in Table 3, does not affect our conclusions. Including the number of healthcare centres within 2 km in the models also does not affect our conclusions.[12]

Our models control for the potential differences in the service utilization between urban and rural areas as the transport infrastructure is relatively weak in the latter category. Next, we investigate whether the relationship between health service utilization for women and children living in rural areas is different from their urban counterpart. To do so, we run separate regressions for rural and urban women and children for all the dependent variables in our analysis. MEs from the logit model indicate that proximity to health centres significantly affects the intake of vitamin A for rural children (Table 4). However, the size of the coefficients in urban and rural areas is comparable, and therefore, we do not rule out that proximity to health centres can affect vitamin A intake in both areas.

Next, we employ an IV approach for estimating the models. Our estimation employed instruments like distance from the nearest madrasa, primary school, high school, post office, and cinema hall. We further added the Heteroscedasticity-based instrument suggested in Lewbel (2012, 2018), which, in our case, assumes that the variance of the error term increases with the distance from the nearest health facility. Table 5 repeats the analysis with the IV approach. Interestingly, we observe a similar conclusion for the exposure variable—distance to the nearest health facility is statistically significant only for vitamin A intake. However, the coefficient is slightly higher than before. Unfortunately, for at least half of the cases, even at the 1% significance level, the Sargan-Hansen test rejects the joint null hypothesis that the instruments are valid.

Table 6 repeats the analysis in Table 4 using the IV approach. We again find that the use of instruments does not affect our conclusions. Again, in several cases, the Sargan-Hansen test rejects the joint null hypothesis that the instruments are uncorrelated with the error term, and that they are correctly excluded from the estimated equation. The rejections thus doubt the validity of our model's instruments. As a result, we emphasize less on the estimates obtained using the IV approach.

The previous analysis thus indicates no significant impact of proximity to health centres on five out of six cases. The only significant effect is observed on children's vitamin A intake. Since our estimates of distances are more likely to be the higher bound of the impact, our findings indicate that setting up new health centres may not increase the utilization of healthcare services. Thus, it would be interesting to investigate the contribution of the Community Clinics in Bangladesh. To do so, using the latest (2017 round of) BDHS data and model (1), we have predicted the service utilization for the counterfactual scenario of having no CC in the country.[13] Comparing the results with the current scenario, we find that the intake of vitamin A would not have been affected at all without the CCs (0.06 pp difference). The reason behind the low impact of CCs is that only a small proportion of people live over 2 km apart from any health centres (7%). This is true even when we do not consider the CCs.

The low impact of health centres can engender from the poor quality of health centres. The local media in Bangladesh and some past studies have criticized the CCs for their lack of a monitoring system to ensure quality service delivery (Bdnews24.com, 2020; GoB, 2019). To investigate the case, we repeat the main analysis when the distance from the nearest health centre of the other type is not further away from the nearest Community Clinic. The results in Table 7 show that the impact of distance on the intake of vitamin A is similar to the case when we also include other types of health

[12]Results are available from the corresponding author upon request.

[13]Here, we implicitly assume that the CCs have not affected the locations of other types of health centres—an assumption likely to hold as CCs are the most basic form of health centres.

TABLE 4 Risk factors related to woman and child health

	Woman health						**Child health**					
	Contraceptive use		**ANC intake**		**PNC intake**		**Vaccine intake**		**Vitamin A intake**		**Advice for fever**	
	Urban	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Proximity to health facility												
Distance ≥ 2 km	0.024	0.013	−0.050	−0.038	−0.052	−0.027	−0.021	−0.042	0.052	−0.065**	−0.014	0.017
	(0.025)	(0.019)	(0.063)	(0.026)	(0.050)	(0.019)	(0.037)	(0.029)	(0.035)	(0.025)	(0.053)	(0.023)
Pseudo-R^2	0.04	0.05	0.18	0.16	0.24	0.18	0.07	0.08	0.08	0.07	0.06	0.04
N	25,753	47,287	8924	18,166	8589	17,340	2398	4825	8519	16,922	3704	8047

Note: See the footnotes of Table 3.

TABLE 5 Risk factors related to women and child health (repeats Table 3 using an IV approach)

	Woman health			Child health		
	Contraceptive use	ANC intake	PNC intake	Vaccine intake	Vitamin A intake	Advice for fever
	(1)	(2)	(3)	(4)	(5)	(6)
Proximity to health facility						
Distance ≥ 2 km	0.014	−0.026	−0.013	−0.071*	−0.082***	0.016
	(0.015)	(0.017)	(0.018)	(0.038)	(0.021)	(0.032)
R^2	0.06	0.22	0.27	0.07	0.09	0.07
Sargan-Hansen test *p*-value	0.01	0.00	0.00	0.03	0.00	0.78
N	72,695	26,974	25,814	7194	25,345	11,697

Note: See the footnotes of Table 3. The estimation used Stata user written code 'IVREG2H', provided by Baum and Schaffer (2021). All independent variables are centred except Distance ≥ 2 km. The Sargan-Hansen test is a test of overidentifying restrictions. The joint null hypothesis is that the instruments are valid instruments, that is, uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. A rejection casts doubt on the validity of the instruments. If the endogenous regressor is a measure of treatment, then the constructed instrument is valid for estimating a treatment effect only if the treatment effect is homogeneous, that is, the same for everyone in the population (Baum and Lewbel, 2019). In our case, the distance dummy is a measure of treatment, and so conditional on treatment homogeneity, we can interpret the coefficient of distance ≥ 2 km as its local average treatment effect (LATE).

centres. The previous finding confirms that the CC' effectiveness in delivering vitamin A to children is not very different from other types of health centres.

We also repeat the analysis separately for urban and rural participants to confirm that the findings apply to both types of regions (Table A3). The result indicates a significant impact of distance on vitamin A intake in rural areas. However, the magnitude of the effect is small and similar to the size we observed earlier. Thus, we do not reject the hypothesis that proximity to the CCs and other health centres barely affects the utilization of essential health services.

Finally, we examine the case when the nearest healthcare centre is either hospital, thana health complex, maternal welfare centre, or maternal and child welfare centre. If the CCs are inferior in quality compared to the other types, the distance is likely to affect health service intake with a higher magnitude for the latter group. Our analysis did not find any support for the hypothesis (Table 8). The results, in a way, indicate that other types of important health facilities are also ineffective in providing the healthcare services we considered in this analysis.[14]

Since children's height and weight were recorded in the BDHS data, we also attempted to estimate the impact of CCs on the incidence of child nutrition—stunting (and severe stunting), wasting (and severe wasting), and underweight (and severe underweight). Our investigation did not find any significant impact of distance from health centres on those outcome measures. We, therefore, dropped the analysis from this manuscript.

While our previous findings align with some earlier studies like GoB (2019) and Hanifi et al. (2020), they seem to oppose the stated preference for nearby health centres. In particular, when asked whether distance to health facilities is a problem, around 43% of respondents in the 2017 round of BDHS have reported 'big problem' against the option 'not a big problem/no problem'. However, the preference is consistent with the fact that some rural outpatients travel further to obtain better treatment when provider quality or reputation is a concern (Qian et al., 2009).

[14]Although delivering the considered services is not the primary objective of those facilities.

TABLE 6 Risk factors related to woman and child health (repeats Table 4 using an IV approach)

	Woman health						**Child health**					
	Contraceptive use		**ANC intake**		**PNC intake**		**Vaccine intake**		**Vitamin A intake**		**Advice for fever**	
	Urban	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Proximity to health facility												
Distance ≥ 2 km	0.020	0.023	−0.033	−0.022	−0.033	−0.016	−0.031	−0.111**	0.061**	−0.113***	−0.009	0.056
	(0.022)	(0.019)	(0.032)	(0.020)	(0.031)	(0.021)	(0.054)	(0.048)	(0.024)	(0.027)	(0.054)	(0.039)
R^2	0.05	0.06	0.23	0.16	0.29	0.21	0.07	0.08	0.09	0.09	0.08	0.04
Sargan-Hansen test *p*-value	0.01	0.07	0.01	0.00	0.01	0.00	0.63	0.02	0.01	0.00	0.64	0.73
N	25,653	47,042	8894	18,080	8560	17,254	2391	4803	8497	16,848	3687	8010

Note: See the footnotes of Table 5.

TABLE 7 Risk factors related to women and child health (repeats Table 3 on observations with the nearest health centre not Community Clinic)

	Woman health			Child health		
	Contraceptive use	ANC intake	PNC intake	Vaccine intake	Vitamin A intake	Advice for fever
	(1)	(2)	(3)	(4)	(5)	(6)
Proximity to health facility						
Distance ≥ 2 km	0.015	−0.044*	−0.043*	−0.042*	−0.052**	0.011
	(0.017)	(0.026)	(0.023)	(0.025)	(0.023)	(0.023)
Pseudo-R^2	0.04	0.20	0.24	0.08	0.07	0.06
N	71,347	26,523	25,394	7046	24,858	11,467

Note: See the footnotes of Table 3.

TABLE 8 Risk factors related to women and child health (repeats Table 3 on observations with the nearest health centre being hospital, thana health complex, maternal welfare centre or maternal and child welfare centre)

	Woman health			Child health		
	Contraceptive use	ANC intake	PNC intake	Vaccine intake	Vitamin A intake	Advice for fever
	(1)	(2)	(3)	(4)	(5)	(6)
Proximity to health facility						
Distance ≥ 2 km	−0.030	−0.079	−0.034	−0.021	−0.042*	−0.028
	(0.026)	(0.049)	(0.041)	(0.030)	(0.025)	(0.045)
Pseudo-R^2	0.04	0.18	0.25	0.09	0.09	0.07
N	13,854	4700	4470	1292	4600	1932

Note: See the footnotes of Table 3. This analysis drops observations from 2004 round of BDHS as the type of facilities were not clear in the data in many cases.

It is worth mentioning that this study suffers from certain limitations. In particular, the study uses survey data, and thus, establishing a causal relationship between the distance from the nearest facility and health service utilization is not foolproof. For example, the study relies on self-reported information in which recall bias can be an issue since the interviewees have been asked questions about past events that go back as far as 3 years. Self-reporting may affect the responses of some demographic and socioeconomic groups differently. If they are correlated with distance and not controlled for in the models, the estimates of the effects can be biased. Fortunately, our IV estimates are less likely to suffer from the issue.

The surveys also excluded women who were dead during the survey period, and so the data of their children were missing. The service intake of those children could be systematically different from those with alive mothers. However, the proportion of deceased mothers was low in the survey, and our results are unlikely to be affected by the issue. It is also important to note that our analysis has not considered many services, including hospital-level services and the provision of free medicines, which can be perceived as more crucial to the survey respondents, which may drive the results. While the centre's distances can be more important for those services, the investigations on the services in this study remain valid and necessary for policy purposes.

6 | POLICY RECOMMENDATIONS

Our previous analysis indicates that poor quality services in the health centres can be a reason to discourage women and children from taking those services. Earlier studies find a significant impact of the quality of service providers on the uptake of health services. For example, hospital treatment practices impact the health service delivery and outcomes (Card et al., 2019). In particular, Card et al. (2019) find that proximity to hospitals with high c-section rates leads to more cesarean deliveries, fewer vaginal births after prolonged labour, and higher average Apgar scores. De Luca et al. (2021) find that the increase in institutional quality significantly decreases cesarean section rates in Italy. Raut and Tanaka (2021) observe improvements in the quality of healthcare services to lead to better health outcomes in conflict-intense areas in Nepal. The same has also been found in earlier studies on Community Clinics in Bangladesh (GoB, 2019; Hanifi et al., 2020).

Thus, some previous studies like Elewonibi et al. (2020) suggested that emphasis should shift from expanding the number of health facilities to improving the quality of services provided. Improving the quality of healthcare centres, including the CC, may thus enhance the utilization of healthcare services in Bangladesh. The quality of the centres depends on many factors, like the availability of equipment and trained service providers and their monitoring and management. Thus, the criticism that the Community Clinics in Bangladesh lack the proper staff and monitoring needs to be addressed to improve the quality of service delivery and consequently raise the uptake of healthcare services for women and children. The same applies to other types of healthcare services in the country.

Making health centres of optimal size can be useful in this regard. A school reform programme in the Brazilian town of Sobral has been successful due to selecting the right candidates as managers (principals) and making schools of optimal size. In particular, the city has merged small schools in outlying areas (where staff commonly taught children in several grades at once) with bigger ones so that students can learn from Sobral's best teachers at reduced costs (Loureiro et al., 2020). Policymakers in the health sector may also consider similar changes.

Mandatory provisions for some services can be another important mechanism to improve healthcare utilization. Previous studies find mandatory vaccination to be associated with higher vaccination coverage in the USA, Australia, and Europe (Hull et al., 2018; Orenstein & Hinman, 1999; Vaz et al., 2020). Orenstein and Hinman (1999) find school immunization laws to have a substantial effect on vaccine-preventable diseases in the school-aged populations in the United States. Hull et al. (2018) documented that the Australian Government's 'No Jab No Pay' policy significantly raised MMR vaccine uptake in the country.[15] Vaz et al. (2020) find that mandatory vaccination is associated with lower measles incidence in European countries.

Like mandatory infant and/or child immunization, compulsory ANC and PNC visits for women and ensuring vaccination and vitamin A intake for children can successfully increase the utilization of those services. The significant impact of distance on vitamin A intake indicates that providing micronutrients and essential minerals like zinc through CC might be an effective strategy to improve child health. As people prefer to take services from the same location, utilizing the mentioned services may encourage the stakeholders to take other services, thus increasing the utilization of other healthcare services. However, successful implementation of mandatory health service utilization needs to be tailored to fit the country's cultural context (MacDonald et al., 2018).

[15] 'No Jab No Pay' is a policy in which the Australian Government withholds the Child Care Benefit, the Child Care Rebate, and a portion of the fortnightly Family Tax Benefit part A per child if children under 20 are neither fully immunized nor on a recognized catch-up schedule.

7 | CONCLUSION

We investigate how distances from the nearest healthcare centre affect service utilization for women and children in Bangladesh and whether the CC in the country raised health service utilization significantly. Using five rounds of nationally representative BDHS data and logistic regression technique, our investigation reveals that proximity to health centres barely affects the country's utilization of healthcare services. The result, together with the fact that a small proportion of people live far from health centres, implies that the newly established CC in the country do not significantly contribute to increasing the utilization of health services offered by them both in rural and urban areas.

Our findings can contribute to the formulation/improvement of health policies in low-income settings by indicating that the proximity to potentially ill-managed/equipped health centres may not be enough to encourage the utilization of health services. The low effectiveness of additional health centres asks for improved infrastructure and human resources in the healthcare centres, including the availability of equipment and trained service providers, as well as their monitoring and management. The governments may also consider mandatory ANC and PNC visits and vaccinations to boost their utilization and thus bring better health outcomes for their countries.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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APPENDIX A

Additional tables

TABLE A1 Risk factors related to woman and child health (repeats Table 3 with ln(distance to the nearest healthcare centre) as the exposure variable)

	Woman health						Child health					
	Contraceptive use		ANC intake		PNC intake		Vaccine intake		Vitamin A intake		Advice for fever	
	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Proximity to health facility												
Ln(distance to facility)	−0.00	−0.00	−0.02	−0.04	−0.01	−0.02	−0.04	−0.04*	−0.04**	−0.05**	0.00	0.00
	(0.01)	(0.01)	(0.02)	(0.03)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
R^2	0.06		0.22		0.27		0.08		0.09		0.07	
Pseudo-R^2		0.04		0.20		0.23		0.08		0.07		0.06
N	73,040	73,040	27,090	27,090	25,929	25,929	7223	7223	25,441	25,441	11,751	11,751

Note: See the footnotes of Table 3.

TABLE A2 Risk factors related to woman and child health (repeats Table 3 with 'no healthcare centre in own village/mohalla' as the exposure variable)

	Woman health						Child health					
	Contraceptive use		ANC intake		PNC intake		Vaccine intake		Vitamin A intake		Advice for fever	
	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit	LPM	Logit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Proximity to health facility												
No centre in own village	−0.004	−0.004	−0.014	−0.018	−0.001	−0.001	−0.020	−0.018	−0.035**	−0.035***	0.007	0.007
	(0.009)	(0.010)	(0.012)	(0.015)	(0.011)	(0.014)	(0.018)	(0.016)	(0.013)	(0.013)	(0.016)	(0.017)
R^2	0.06		0.22		0.27		0.08		0.09		0.07	
Pseudo-R^2		0.04		0.20		0.23		0.07		0.07		0.06
N	73,040	73,040	27,090	27,090	25,929	25,929	7223	7223	25,441	25,441	11,751	11,751

Note: See the footnotes of Table 3.

TABLE A3 Risk factors related to woman and child health (repeats Table 4 on observations with the nearest health centre not Community Clinic)

	Woman health						**Child health**					
	Contraceptive use		**ANC intake**		**PNC intake**		**Vaccine intake**		**Vitamin A intake**		**Advice for fever**	
	Urban	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Proximity to health facility												
Distance ≥ 2 km	0.024	0.012	−0.050	−0.040*	−0.052	−0.035	−0.021	−0.046	0.052	−0.066**	−0.014	0.015
	(0.025)	(0.019)	(0.063)	(0.024)	(0.050)	(0.022)	(0.037)	(0.029)	(0.035)	(0.026)	(0.053)	(0.024)
Pseudo-R^2	0.04	0.05	0.18	0.16	0.24	0.18	0.07	0.08	0.08	0.07	0.06	0.04
N	25,666	45,681	8910	17,613	8575	16,819	2393	4653	8494	16,364	3693	7774

Note: See the footnotes of Table 3.

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