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Climate-related displacement and continuity of maternal health care, Bangladesh

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Abstract

Objective To examine whether displacement caused by climate-related hazards is associated with continuity of maternal health care across antenatal care, skilled birth attendance and postnatal care in Bangladesh.

Methods We analysed data from a 2023–2024 United Nations Population Fund cross-sectional survey of women with a child aged five years or younger in four climate-vulnerable districts of Bangladesh. Continuity of care was classified as low (none of four or more antenatal visits, skilled birth attendance and postnatal care), moderate (one or two of these services) or high (all three). Exposures were displacement status, frequency of displacement, type of hazard, and onset type. Multinomial logistic regression assessed associations while adjusting for potential confounders.

Findings Only 312 of 2408 participants (13.0%) achieved high continuity of care, including 20.8% of nondisplaced women (250/1203) and 5.2% of displaced women (62/1205). Compared with nondisplaced women, those who were displaced were less likely to achieve moderate (aRRR: 0.31; 95% confidence interval, CI: 0.25–0.38) and high continuity of care (aRRR: 0.16; 95% CI: 0.11–0.22). The association between displacement and lower continuity of care was stronger among women who had experienced repeated displacement and those affected by slow-onset hazards (high continuity of care: aRRR: 0.03; 95% CI: 0.01–0.05), particularly riverbank erosion.

Conclusion Climate-related displacement was associated with substantially lower continuity of maternal health care in districts where slow-onset hazards predominated. Maternal health services in disaster-prone areas need to maintain continuity of care during displacement and return, and this approach should be included in disaster preparedness plans.

Introduction

Ensuring that women have appropriate care along the pathway from pregnancy, through childbirth and the postnatal period is important for preventing avoidable maternal and newborn deaths.[1] Continuity of care across this pathway requires the provision of recommended maternal health services, including antenatal care, skilled birth attendance and postnatal care,[2] with each component serving a distinct clinical function. Antenatal care enables the identification and management of conditions such as hypertensive disorders, anaemia and infection, and helps women prepare for childbirth; skilled birth attendance supports the recognition and management of complications such as haemorrhage and obstructed labour; and postnatal care provides care up to six weeks after birth when women and newborns are at high risk of complications, illness and death.[2–4] When women miss contacts along this pathway, the benefit of earlier care may be lost, because risks identified during pregnancy may not be addressed by skilled care at birth and complications after birth may go undetected.[2,5] Although use of individual services has increased in many low-and middle-income countries, completion of the full pathway remains low.[6,7] For example, in Bangladesh, an estimated 65% of births had a skilled attendant in 2022,[8] but only 2295 (25.0%) of 9183 women surveyed in 2019 completed all three services.[7]

Bangladesh has long experienced floods, riverbank erosion and tropical cyclones because of its position on the delta of the Ganges, Brahmaputra and Meghna rivers and its low-lying coast on the Bay of Bengal.[9,10] Population movement in response to these hazards is not new.[10,11] However, severe events can cause widespread damage and disruption to health facilities, transport and communication,[12–14] and displacement can also separate women from the health providers who know them.[15,16]

Reported climate- and weather-related disasters have increased globally over recent decades, although partly because of better reporting.[17] Exposure to these hazards among riverine and coastal populations in Bangladesh has also increased and is expected to grow further.[9,10] We use the term climate-related displacement to refer to the forced movement of households from their usual place of residence in response to hydro-meteorological hazards whose frequency or severity may be influenced by human-induced climate change. This term does not imply that any individual flood, riverbank erosion or cyclone has been attributed to climate change, or of the resulting displacement.

The extent to which displacement disrupts continuity of care is unclear. Studies from Bangladesh on maternal health-care utilization in flood-affected and highly disaster-prone areas have reported lower use of maternal services.[18,19] However, existing studies have examined individual maternal health services rather than the continuity of care across the pregnancy, childbirth and postnatal period. They have also generally focused on either slow-onset hazards, such as riverbank erosion, which unfolds over months or years and often cause gradual and permanent loss of land and homes, or rapid-onset events, such as cyclones and storm surges, which occur within hours or days and usually cause sudden, often temporary, displacement.[20,21]

This study therefore aimed to assess in Bangladesh whether displacement is associated with lower continuity of care beyond the effect of living in a hazard-prone area, and whether any association differs by the frequency of displacement or by slow-onset and rapid-onset hazards. The findings may inform adaptions to maternal health services in climate-vulnerable districts.

Methods

We designed a cross-sectional household survey to compare continuity of maternal care among women of reproductive age displaced by climate-related hazards and nondisplaced women living in the same districts in Bangladesh. The United Nations Population Fund (UNFPA) in Bangladesh funded and conducted the survey.

Of the country's 64 districts, we identified 24 districts with high levels of climate-related displacement from published reports.[10,11,22] Of these, 12 coastal districts were mainly exposed to cyclones and storm surges (rapid-onset) and 12 districts, located in major river basins, were mainly exposed to riverbank erosion and flooding (slow-onset).[10,11,22] We purposively selected four districts, two riverine and two coastal, based on their risk levels in the INFORM Subnational Risk Index Bangladesh 2022 and their hazard profiles.[23] Gaibandha and Sirajganj are situated along the Brahmaputra–Jamuna river basins and include char (river island) areas affected by erosion and flooding, whereas Patuakhali and Barguna lie on the Bay of Bengal coast and are exposed to cyclones and storm surges.[10,11,22] These districts were selected to capture both major hazard settings and were not representative of all 24 districts. Of the 30 upazilas (subdistricts) in the four districts, we purposively selected 16, four per district, based on their risk levels. Within these upazilas, unions were selected through consultation with local stakeholders.

We then conducted household listing in the selected unions to construct the sampling frame, from which households were selected using systematic random sampling.

The Ethics Committee of the Institute of Disaster Management and Vulnerability Studies, University of Dhaka, Bangladesh, approved the study (ERC-EXT-23/282023).

Study population and sampling

Inclusion criteria were women aged 15–49 years with at least one child aged five years or younger living in one of the four districts. We compiled a sampling frame of approximately 7000 eligible women in the selected upazilas, recording each woman as displaced or nondisplaced through household listing. Women were selected by simple random sampling within each displacement group and district. When a selected woman was absent or unreachable, we replaced her with another randomly selected eligible woman from the sampling frame, who lived in the same district and belonged to the same displacement group. In total, 125 selected women were replaced, mainly because they were not available during interview.

We calculated the sample size as $n = z^2pq/d^2 \times d_{eff}$, with z: 1.96, an expected skilled birth attendance prevalence of 65% (p: 0.65) from the 2022 Bangladesh DHS,[8] q defined as 1−p, a margin of error of 5% (d: 0.05) and a design effect (d_{eff}) of 1.5, assumed to account for clustering within upazilas, resulting in 525 women per district. After adding 10% for non-response, the target was 578 women per district, divided equally between displaced and nondisplaced women to give similar precision for both groups, for a planned total of 2312 women. We based the calculation on skilled birth attendance because it links antenatal and postnatal care and had a recent national estimate.

Data collection

We adapted the questionnaire from the Bangladesh DHS and MICS,[8] and pretested it with 20 women in a non-study area. The survey was programmed in the KoBoToolbox platform (Kobo Inc., Cambridge, United States of America) and is available in the online repository.[24]

Between December 2023 and March 2024, trained female fieldworkers, independent of UNFPA and the study team, conducted interviews with women using a structured questionnaire in Bangla. Fieldworkers visited selected women at home and invited them to take part in the survey. Interviews lasted 35–45 minutes and took place in the participant's home in a private

space after informed verbal consent had been obtained. For women aged 15–17 years, consent from a parent or guardian was obtained. Participation was voluntary and women could skip questions or stop the interview at any time.

Conceptual framework

To guide our choice of exposures and covariates, we developed a conceptual framework informed by the literature on climate-related hazards, displacement and maternal health-care use (Fig. 1).[12–16,25] Exposure to a climate-related hazard can lead to displacement, which varies by occurrence, frequency, onset type and duration. We hypothesized four pathways through which displacement might reduce continuity of care, which included disruption of health services, physical access barriers, economic hardship and social disruption. Because poverty and low levels of formal education may increase the risk of displacement and lower use of care, we adjusted for individual, household and district characteristics. We did not measure distance to facilities, quality of care, women's autonomy and social support and are shown as potential unmeasured confounders.

Outcome variables

The outcome was self-reported continuity of care across three services during the most recent pregnancy, which comprised four or more antenatal care visits, skilled birth attendance and postnatal care for both the mother and the newborn within 24 hours of birth. We used four antenatal care visits rather than the eight contacts recommended by the World Health Organization (WHO).[3] This decision was based on the Bangladesh national guideline on antenatal care during the study period, which recommended at least four visits,[26] and the use of four or more visits as an indicator in the Bangladesh DHS and MICS,[8,27] which allowed comparison with national estimates. Providers of skilled care at birth and postnatal care were classified following definitions used in the Bangladesh DHS,[5,8] and postnatal care was counted only when both the woman and the newborn were checked by a skilled provider within 24 hours of birth, when risks of complications and death are highest.[4] We grouped women into three levels of continuity of care: low if they reported having received none of the three services; moderate, if they reported having received one or two of the three services; and high, if they reported having received all three. For example, a woman who made two out of the four recommended antenatal care visits, had a skilled birth attendant during childbirth and whose

newborn was not checked within 24 hours was categorized as having moderate continuity of care. We used three levels rather than a binary outcome because combining no care with partial care would obscure differences that may require different responses from the health services.

Exposure variables

We classified a woman as displaced if she reported that her household had been forced to leave its usual place of residence because of a climate-related hazard at any time before the interview, and as nondisplaced if she reported that she had not relocated. Those who identified as displaced reported the frequency of displacement (once, twice or three or more times) and the type of hazard responsible (riverbank erosion; cyclone or storm surge; or other hazards, namely flood, coastal erosion or waterlogging). We assigned hazard onset type (slow or rapid) according to the district's hazard profile rather than the specific hazard experienced by each participant.[23] Onset type is therefore an area-level classification and does not always match the hazard type reported by participants. Because district was also included in the adjusted models, we used onset-type estimates to compare displaced with nondisplaced women within the slow-onset and within the rapid-onset districts. Differences between onset types may therefore also reflect other differences between districts. We did not assess the duration of displacement and its timing relative to the most recent pregnancy.

Covariates

We identified covariates from our conceptual framework and previous studies on continuity of maternal care in Bangladesh and Ethiopia.[5,7,28,29] Potential covariates included age, education level and occupation, number of children ever born, partner's education level and occupation, monthly household income, and district. We retained covariates using forward selection, with a *P*-value: < 0.20 for entry and < 0.10 for retention in the multivariable model. All potential covariates met these criteria and were included in the adjusted models.

Statistical analysis

We used multinomial logistic regression with low continuity of care level as the base outcome and nondisplaced women as the reference group, in separate models for displacement status, frequency, hazard type and onset type, each with the same covariates. Relative risk ratios (RRR) compare the relative risk of moderate, or high, versus low continuity of care between each exposure group and nondisplaced women and values below 1 indicate a lower likelihood of

better continuity. We report crude and adjusted RRR (aRRR) with 95% confidence intervals (CI). Because adjusted models included district, they compare displaced and nondisplaced women within the same district; crude models compare women across the four districts. Estimates were considered significant at $P < 0.05$ in Wald tests. Multicollinearity was assessed using variance inflation factors. Participants missing information on household income were excluded from adjusted models (complete-case analysis). We applied survey weights in all analyses using Stata version 17 (StataCorp, College Station, United States of America). Reporting follows the Strengthening the Reporting of Observational Studies in Epidemiology guideline (online repository).[24]

Results

We conducted interviews with 2408 participants, of which 1205 had experienced displacement, and of these, 653 (54.2%) had been displaced once and 552 (45.8%) at least twice, mainly because of riverbank erosion (865; 71.8%) and cyclones or storm surges (289; 24%). Of the 865 displaced women who reported riverbank erosion, only 604 lived in slow-onset districts, suggesting that at least 261 participants in the rapid-onset districts had been displaced by erosion. Most participants were aged 20–34 years (1844; 76.6%). Nearly half had secondary education (1141; 47.4%) and 661 (27.4%) had more than two children (Table 1).

Continuity of care

Among the 2408 participants, 1935 (80.4%) reported at least one antenatal care contact and 497 (20.6%) made four or more visits. A skilled attendant at birth was reported by 1458 (60.5%) participants and 926 (38.5%) received postnatal care for both woman and newborn within 24 hours (Table 2 and Table 3). Service use was higher among women with more education, better-educated partners, fewer children and higher incomes (Table 3). Overall, 843 women (35%) had low continuity of care, 1253 (52%) had moderate and 312 (13%) had high (Table 4).

The largest gap was between the first and the fourth antenatal care visits (Fig. 2), as 74.3% of women (1438/1935) who initiated antenatal care did not attend four visits. The proportion was higher among displaced participants (86.2%; 744/863), than nondisplaced (64.7%; 694/1072). Only 119 of 863 (13.8%) displaced women who initiated antenatal care made four visits, compared with 378 of 1072 nondisplaced women (35.3%). Women who experienced displacement were also less likely to initiate antenatal care (863/1205; 71.6%,

versus 1072/1203; 89.1%). Among women who attended antenatal care at least four or more times, and had a skilled attendant at birth, 29.5% (26/88) of those displaced and 23.3% (76/326) of those nondisplaced did not receive postnatal care within 24 hours.

Low continuity of care was more common among displaced than nondisplaced women (52.2%, 629/1205 vs 17.8%; 214/1203; Table 4). Among displaced women, it was most frequent among those displaced twice (60.7%; 136/224), followed by those displaced three or more times (57.9%; 190/328) and once (46.4%; 303/653). High continuity of care declined with repeated displacement, from 7.8% (51/653) after one displacement to 3.1% (7/224) after two and 1.2% (4/328) after three or more. Low continuity of care was more common following riverbank erosion (57.6%; 498/865) than cyclones or storm surges (36.7%; 106/289), and following slow-onset (67.2%; 406/604) than rapid-onset displacement (36.9%; 222/601). High continuity of care was more common among participants with higher educational attainment (36.3%; 99/271) and those with a partner who had higher education (24.9%; 93/373) as well as among households with a monthly income above 20 000 Bangladeshi taka (about 180 United States dollars; 24.2%; 145/599).

Displacement and continuity of care

In adjusted models (Table 5; full models available in the online repository),[24] displaced women were less likely than nondisplaced women to have moderate or high continuity of care, rather than low continuity of care (aRRR: 0.31, 95% CI: 0.25–0.38, and 0.16, 95% CI: 0.11–0.22, respectively). The association between displacement and low continuity of care was particularly pronounced for the highest category of continuity of care. Compared with nondisplaced women, the adjusted relative risk ratio for having high rather than low continuity of care was 0.27 (95% CI: 0.18–0.41) among women displaced once, 0.09 (95% CI: 0.04–0.20) among those displaced twice, and 0.03 (95% CI: 0.01–0.07) among those displaced three or more times.

Compared with nondisplaced women, those affected by slow-onset hazard-related displacement were less likely to have moderate continuity of care (aRRR: 0.14; 95% CI: 0.10–0.19) or high continuity of care (aRRR: 0.03; 95% CI: 0.01–0.05). Associations were weaker for rapid-onset displacement (moderate aRRR: 0.72; 95% CI: 0.54–0.95; high aRRR: 0.52; 95% CI: 0.34–0.80). Compared with nondisplaced women, those affected by riverbank erosion had the lowest relative likelihood of moderate or high continuity of care (moderate aRRR: 0.27; high

aRRR: 0.10). Across hazard types, displacement was associated with a 52.0–73.0% lower relative likelihood of moderate continuity of care and a 62.0–90.0% lower relative likelihood of high continuity of care compared with nondisplacement.

Discussion

In four climate-vulnerable districts of Bangladesh, about one in eight of the participants reported receiving all three recommended maternal health services. After adjustment for socioeconomic characteristics and district, participants who had experienced displacement were less likely than those who had not been displaced in the same district to achieve moderate or high continuity of care. The association was strongest for repeated displacement and slow-onset hazard-related displacement, particularly following riverbank erosion.

Low continuity of care was also common among nondisplaced women. Only a fifth reached high continuity of care and less than a third had four or more antenatal care contacts.

The overall proportion of receiving high continuity of care is similar to the 2014 DHS national estimate of 12.0%, but lower than the more recent national estimate of 25.0% from the 2019 Multiple Indicator Cluster Survey,[5,27] which suggests that these districts lag behind national progress irrespective of displacement. The displacement gap, therefore, exists within an already underserved population, so comparison with national averages would probably show a larger disadvantage. Some factors that lower continuity of care in these districts affect all residents, not only those who have experienced displacement. Such factors include difficulty retaining health workers, repeated damage to health facilities, limited access to health services for communities living on chars, particularly where travel requires crossing rivers, and the diversion of local administrative attention to relief and shelter after disasters.[13,14] The low coverage of the three recommended maternal health services among nondisplaced women indicates systemic gaps in maternal health care in disaster-prone areas, to which displacement adds a further disadvantage.

The pathways outlined in our conceptual framework may help explain the lower continuity of care among participants who experienced displacement, although we could not directly test these pathways. Displacement creates urgent needs for food, shelter and financial resources, which may lead households to prioritize these over routine maternal health care and seek care only when complications arise.[25,30] Relocation may also separate women from the health facilities and community health workers that would support them during pregnancy.[31] In

our study displaced women were less likely to initiate antenatal care and substantially less likely to have four contacts. However, households that experienced displacement may have also been poorer or less educated than nondisplaced households, even before displacement, and adjustment for current socioeconomic status may not fully account for these pre-existing differences. In addition, adjusting for current income may account for part of an effect of displacement on continuity of care that operates through the loss of income caused by displacement.

The strong association between slow-onset hazards and displacement is plausible. Riverbank erosion often destroys land and homes permanently, so displacement is prolonged, whereas displacement after a cyclone is often shorter and followed by return.[20] Health facilities in erosion-prone areas may be lost permanently, while those in cyclone-affected areas more often close temporarily.[20,32] Rapid-onset hazards that cause substantial damage also attract more media and humanitarian attention, whereas attention to slow-onset hazard-related displacement tends to diminish over time.[21,32] However, because onset type was assigned by district, it cannot be separated from other differences between the northern riverine and southern coastal districts, including differences in health services and programmes. The finding should therefore be interpreted as a difference between two hazard settings rather than an effect of onset speed alone.

Gaps in continuity of care matter because each stage of care provides an opportunity to detect and manage risk.[2–4] Health services in disaster-prone areas in Bangladesh therefore need to follow women during displacement and return. Interventions to maintain continuity of maternal health care could include registering pregnant women in shelters and resettlement sites and linking them to the nearest health facility. Community health workers and midwives could be deployed to char and coastal areas and the provision of mobile or boat-based outreach where health facilities have been lost. Portable or digital maternal health records and mobile phone reminders could help women maintain contact with health facilities when they move. Financial assistance for transport to health facilities and costs of childbirth could further support women's access to services.[30,33,34] Community-based care and mobile phone reminders have been used in other low-resource settings,[33,34] but their feasibility after disasters will depend on staff, funding and transport. Maternal health should also be included in national climate adaptation and disaster preparedness plans, including the *National strategy on internal displacement management*.[21] These recommendations may also be relevant to other disaster-prone settings. For example, after the 2022 floods in Pakistan, about 1000 family health service centres were reported to be

affected[35] and maternal and child health services were disrupted in Mozambique after Cyclone Idai in March 2019, when first antenatal care visits fell by 23% before recovering within about three months.[36]

This study has several strengths. The study included a large sample and outcome definitions aligned with WHO and national indicators. In addition, it compared continuity of care between women in slow-onset and rapid-onset settings, that may help inform future interventions to prevent disruption of maternal care during displacement.

The study also has limitations. The cross-sectional design does not allow causal inference or establish the timing of displacement in relation to care-seeking, particularly because displacement before, during and after the most recent pregnancy was combined. Residual confounding is possible, because we did not measure distance to health facilities, quality of care, women's autonomy, social support and socioeconomic status before displacement. Service use was self-reported and may be subject to recall bias, especially for participants whose youngest child was several years old. In addition, we classified onset type by district and may not reflect the duration, permanence or reversibility of individual displacement. Replacing women who could not be reached may have also introduced selection bias if they differed from those interviewed, for example, if they had moved more often. Finally, the four districts were not selected to be representative of all climate-vulnerable districts in Bangladesh. Prospective longitudinal studies that record the timing and duration of displacement in relation to pregnancy, childbirth and postnatal care are needed to understand how displacement affects continuity of care.

To conclude, in climate-vulnerable districts of Bangladesh, where maternal continuity of care was already low, displaced women were less likely to receive recommended antenatal care, skilled birth attendance and postnatal care, particularly after repeated or slow-onset displacement. As climate-related hazards continue to displace women, families and communities, maternal health services should be designed to follow women through displacement and return, and continuity of care should be integrated into climate adaptation, disaster preparedness and displacement response policies.

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Competing interests:

None declared.

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Table 1. **Characteristics of participants and households, four climate-vulnerable districts, Bangladesh, 2023–2024**

Participant and household characteristics	No. (%) (*n* = 2408)[a]
Age, years	
≤ 19	300 (12.4)
20–34	1844 (76.6)
≥ 35	264 (11)
Education	
No formal education	167 (6.9)
Primary	829 (34.4)
Secondary	1141 (47.4)
Higher	271 (11.3)
Occupation	
Housewife	2341 (97.2)
Other[b]	67 (2.8)
No. of children ever born	
1–2 children	1747 (72.6)
> 2 children	661 (27.4)
Partner's education	
No formal education	508 (21.1)
Primary	811 (33.7)
Secondary	716 (29.7)
Higher	373 (15.5)
Partner's occupation	
Agriculture worker	862 (35.8)
Physical worker[c]	833 (34.6)
Services	322 (13.4)
Business	346 (14.4)
Other	45 (1.9)
Household monthly income, Bangladeshi taka (*n* = 2405)	
≤ 10 000	512 (21.3)
10 001–20 000	1294 (53.8)
> 20 000	599 (24.9)
District	
Gaibandha	604 (25.1)
Sirajganj	603 (25)
Patuakhali	600 (24.9)
Barguna	601 (25)
Displacement status	
Nondisplaced	1203 (50)
Displaced	1205 (50)
Frequency of displacement (*n* = 1205)	
Once	653 (54.2)
Twice	224 (18.6)
Three or more times	328 (27.2)
Type of hazard leading to displacement (*n* = 1205)	
Riverbank erosion	865 (71.8)
Cyclone or storm surge	289 (24)
Other[d]	51 (4.2)
Onset type of displacement (*n* = 1205)	
Slow-onset	604 (50.1)
Rapid-onset	601 (49.9)

[a] This is the sample size unless otherwise stated.

[b] Include paid domestic work in another household, livestock or poultry rearing, government or private employment, teaching, small business, agricultural day labour, fishing, handicrafts, tailoring, and other non-agricultural day labour (casual daily-paid work outside agriculture not classified under the occupations listed above).

[c] Manual non-agriculture labour.

[d] Include flooding, coastal erosion and waterlogging.

Notes: percentages for frequency, type of hazard and onset type are of displaced women (n = 1205). Household income was missing for three participants. During the study period, 1 Bangladeshi taka averaged 0.009 United States dollars.

Table 2. **Classification of continuity of maternal health care, Bangladesh, 2023–2024**

Childbirth and postnatal care	Antenatal care			
	< 4 visits (*n* = 1911)		≥ 4 visits (*n* = 497)	
	No. (%)	Level of care	No. (%)	Level of care
Skilled birth attendance				
Assisted birth (*n* = 1458)	1044 (54.6)	Moderate	414 (83.3)	High
No assisted birth (*n* = 950)	867 (45.4)	Low	83 (16.7)	Moderate
Postnatal care for mothers and newborns				
Received care within 24 hours of birth (*n* = 926)	610 (31.9)	Moderate	316 (63.6)	High
No care received within 24 hours of birth (*n* = 1482)	1301 (68.1)	Low	181 (36.4)	Moderate

Notes: because each cross-tabulation involves only two services, a cell labelled moderate can include women who received the third service. Similarly, a cell labelled low can include women who received the third service, and a cell labelled high can include women who did not receive it.

Table 3. **Use of maternal health services by sociodemographic characteristics, Bangladesh, 2023–2024**

Participant characteristics	Maternal health service received, no. (%) (*n* = 2408)[a]			
	≥ 1 antenatal care visit	≥ 4 antenatal care visits	Skilled birth attendance	Postnatal care for mother and newborn within 24 hours
Overall (*n* = 2408)	**1935 (80.4)**	**497 (20.6)**	**1458 (60.5)**	**926 (38.5)**
Age, years				
≤ 19 (*n* = 300)	238 (79.3)	45 (15.0)	164 (54.7)	95 (31.7)
20–34 (*n* = 1844)	1497 (81.2)	415 (22.5)	1141 (61.9)	741 (40.2)
≥ 35 (*n* = 264)	199 (75.4)	37 (14.0)	153 (58.0)	90 (34.1)
Education				
No formal education (*n* = 167)	107 (64.1)	18 (10.8)	67 (40.1)	34 (20.4)
Primary (*n* = 829)	586 (70.7)	94 (11.3)	400 (48.3)	230 (27.7)
Secondary (*n* = 1141)	984 (86.2)	257 (22.5)	748 (65.6)	486 (42.6)
Higher (*n* = 271)	259 (95.6)	128 (47.2)	242 (89.3)	176 (64.9)
Occupation				
Housewife (*n* = 2341)	1887 (80.6)	482 (20.6)	1419 (60.6)	901 (38.5)
Other[b] (*n* = 67)	49 (73.1)	15 (22.4)	40 (59.7)	26 (38.8)
Number of children ever born				
1–2 (*n* = 1747)	1452 (83.1)	395 (22.6)	1101 (63.0)	713 (40.8)
> 2 (*n* = 661)	483 (73.1)	102 (15.4)	357 (54.0)	213 (32.2)
Partner's education				
No formal education (*n* = 508)	357 (70.3)	59 (11.6)	228 (44.9)	126 (24.8)
Primary (*n* = 811)	613 (75.6)	110 (13.6)	437 (53.9)	258 (31.8)
Secondary (*n* = 716)	625 (87.3)	192 (26.8)	501 (70.0)	340 (47.5)
Higher (*n* = 373)	340 (91.2)	136 (36.5)	292 (78.3)	202 (54.2)
Partner's occupation[c]				
Agriculture worker (*n* = 862)	672 (78.0)	135 (15.7)	444 (51.5)	266 (30.9)
Physical worker (*n* = 833)	632 (75.9)	136 (16.3)	477 (57.3)	296 (35.5)
Services (*n* = 322)	287 (89.1)	105 (32.6)	242 (75.2)	165 (51.2)
Business (*n* = 346)	309 (89.3)	112 (32.4)	269 (77.8)	183 (52.8)
Other (*n* = 45)	35 (77.8)	9 (20)	26 (57.8)	17 (37.8)
Household monthly income (Bangladeshi taka)				
≤ 10 000 (*n* = 512)	354 (69.1)	57 (11.1)	246 (48.1)	129 (25.2)
10 001–20 000 (*n* = 1294)	1049 (81.1)	226 (17.5)	767 (59.3)	484 (37.4)
> 20 000 (*n* = 599)	528 (88.2)	212 (35.4)	442 (73.8)	311 (51.9)

[a] This is the sample size unless otherwise stated.

[b] Include paid domestic work in another household, livestock or poultry rearing, government or private employment, teaching, small business, agricultural day labour, fishing, handicrafts, tailoring, and other non-agricultural day labour (casual daily-paid work outside agriculture not classified under the occupations listed above).

[c] Agricultural workers undertook farming or agricultural labour; physical workers undertook manual labour outside agriculture. Services comprised salaried or wage-paid service employment, whereas business comprised self-employment through owning or running a business. Other included occupations outside these categories.

Notes: household income was missing for three participants. During the study period, 1 Bangladeshi taka averaged 0.009 United States dollars.

Table 4. **Continuity of care levels by displacement and participant sociodemographic characteristics, Bangladesh, 2023–2024**

Characteristics	Level of continuity of care, no. (%)		
	Low	Moderate	High
All participants (*n* = 2408)	843 (35.0)	1253 (52.0)	312 (13.0)
Displacement status			
Nondisplaced (*n* = 1203)	214 (17.8)	739 (61.4)	250 (20.8)
Displaced (*n* = 1205)	629 (52.2)	514 (42.7)	62 (5.2)
Frequency of displacement			
Once (*n* = 653)	303 (46.4)	299 (45.8)	51 (7.8)
Twice (*n* = 224)	136 (60.7)	81 (36.2)	7 (3.1)
Three or more times (*n* = 328)	190 (57.9)	134 (40.9)	4 (1.2)
Type of hazard leading to displacement			
Riverbank erosion (*n* = 865)	498 (57.6)	337 (39.0)	30 (3.5)
Cyclone or storm surge (*n* = 289)	106 (36.7)	155 (53.6)	28 (9.7)
Others[a] (*n* = 51)	25 (49.0)	22 (43.1)	4 (7.8)
Onset type of displacement			
Slow-onset (*n* = 604)	406 (67.2)	189 (31.3)	9 (1.5)
Rapid-onset (*n* = 601)	222 (36.9)	326 (54.2)	53 (8.8)
Age, years			
≤ 19 (*n* = 300)	117 (39.0)	159 (53.0)	24 (8.0)
20–34 (*n* = 1 844)	620 (33.6)	956 (51.8)	268 (14.5)
≥ 35 y (*n* = 264)	106 (40.2)	138 (52.3)	20 (7.6)
Education			
No formal education (*n* = 167)	91 (54.5)	72 (43.1)	4 (2.4)
Primary (*n* = 829)	401 (48.4)	382 (46.1)	46 (5.6)
Secondary (*n* = 1141)	328 (28.8)	650 (57.0)	163 (14.3)
Higher (*n* = 271)	23 (8.5)	149 (55.0)	99 (36.3)
Occupation			
Housewife (*n* = 2341)	819 (35.0)	1219 (52.1)	304 (13.0)
Other[b] (*n* = 67)	24 (35.8)	34 (50.8)	9 (13.4)
Number of children ever born			
1–2 (*n* = 1 747)	569 (32.6)	919 (52.6)	259 (14.8)
> 2 (*n* = 661)	273 (41.3)	335 (50.7)	53 (8.0)
Partner's education			
No formal education (*n* = 508)	263 (51.8)	217 (42.7)	28 (5.5)
Primary (*n* = 811)	332 (40.9)	424 (52.3)	55 (6.8)
Secondary (*n* = 716)	186 (26.0)	394 (55.0)	136 (19.0)
Higher (*n* = 373)	62 (16.6)	218 (58.5)	93 (24.9)
Partner's occupation[c]			
Agriculture worker (*n* = 862)	372 (43.2)	411 (47.7)	79 (9.2)
Physical worker (*n* = 833)	323 (38.8)	439 (52.7)	71 (8.5)
Services (*n* = 322)	68 (21.1)	178 (55.3)	76 (23.6)
Business (*n* = 346)	64 (18.5)	201 (58.1)	81 (23.4)
Others (*n* = 45)	16 (35.6)	24 (53.3)	5 (11.1)
Household monthly income (Bangladeshi taka)			
≤ 10 000 (*n* = 512)	246 (48.1)	237 (46.3)	29 (5.7)
10 001–20 000 (*n* = 1294)	479 (37.0)	679 (52.5)	136 (10.5)
> 20 000 (*n* = 599)	118 (19.7)	336 (56.1)	145 (24.2)

[a] Include flooding, coastal erosion, waterlogging.

[b] Include paid domestic work in another household, livestock or poultry rearing, government or private employment, teaching, small business, agricultural day labour, fishing, handicrafts, tailoring, and other non-agricultural day labour (casual daily-paid work outside agriculture not classified under the occupations listed above).

[c] Agricultural workers undertook farming or agricultural labour; physical workers undertook manual labour outside agriculture. Services comprised salaried or wage-paid service employment, whereas business comprised self-employment through owning or running a business. Other included occupations outside these categories.

Notes: low continuity of care was defined as fewer than four antenatal care visits, no skilled birth attendance and no postnatal care; moderate as receipt of one or two of these three services; and high as receipt of all three services. Household income was missing for three participants. During the study period, 1 Bangladeshi taka averaged 0.009 United States dollars.

Table 5. **Multinomial logistic regression of continuity of care levels on displacement characteristics, Bangladesh, 2023–2024**

Characteristics	Moderate vs low level		High vs low level	
	cRRR (95% CI)	aRRR (95% CI)	cRRR (95% CI)	aRRR (95% CI)
Displacement status				
Nondisplaced (ref)	1.00	1.00	1.00	1.00
Displaced	0.24 (0.19–0.29)	0.31 (0.25–0.38)	0.08 (0.06–0.12)	0.16 (0.11–0.22)
Frequency of displacement				
Nondisplaced (ref)	1.00	1.00	1.00	1.00
Once	0.29 (0.23–0.36)	0.35 (0.27–0.44)	0.14 (0.10–0.20)	0.27 (0.18–0.41)
Twice	0.17 (0.13–0.24)	0.25 (0.18–0.35)	0.04 (0.02–0.10)	0.09 (0.04–0.20)
Three or more times	0.20 (0.16–0.27)	0.29 (0.22–0.40)	0.02 (0.01–0.05)	0.03 (0.01–0.07)
Type of hazard leading to displacement				
Nondisplaced (ref)	1.00	1.00	1.00	1.00
Riverbank erosion	0.20 (0.16–0.24)	0.27 (0.22–0.34)	0.05 (0.03–0.08)	0.10 (0.06–0.16)
Cyclone or storm surge	0.42 (0.32–0.57)	0.48 (0.34–0.68)	0.23 (0.14–0.36)	0.38 (0.22–0.65)
Other[a]	0.25 (0.14–0.46)	0.28 (0.15–0.52)	0.14 (0.05–0.40)	0.22 (0.07–0.68)
Onset type of displacement				
Nondisplaced (ref)	1.00	1.00	1.00	1.00
Slow-onset	0.14 (0.11–0.17)	0.14 (0.10–0.19)	0.02 (0.01–0.04)	0.03 (0.01–0.05)
Rapid-onset	0.43 (0.34–0.54)	0.72 (0.54–0.95)	0.21 (0.14–0.29)	0.52 (0.34–0.80)

aRRR: adjusted relative risk ratio; CI: confidence interval; cRRR: crude relative risk ratio; ref: reference group.

[a] Include flooding, coastal erosion, waterlogging.

Notes: low continuity of care is the base outcome, and each block is a separate model with nondisplaced women as the reference group; an RRR below 1 indicates that displaced women have a lower relative risk of moderate (or high) continuity of care rather than low continuity of care, than nondisplaced women. Adjusted models include age, education and occupation, number of children ever born, partner's education and occupation, household monthly income and district; full models are available in the online repository.[24]

Fig. 1. **Conceptual framework of the hypothesized pathways from climate-related displacement to continuity of maternal health care**

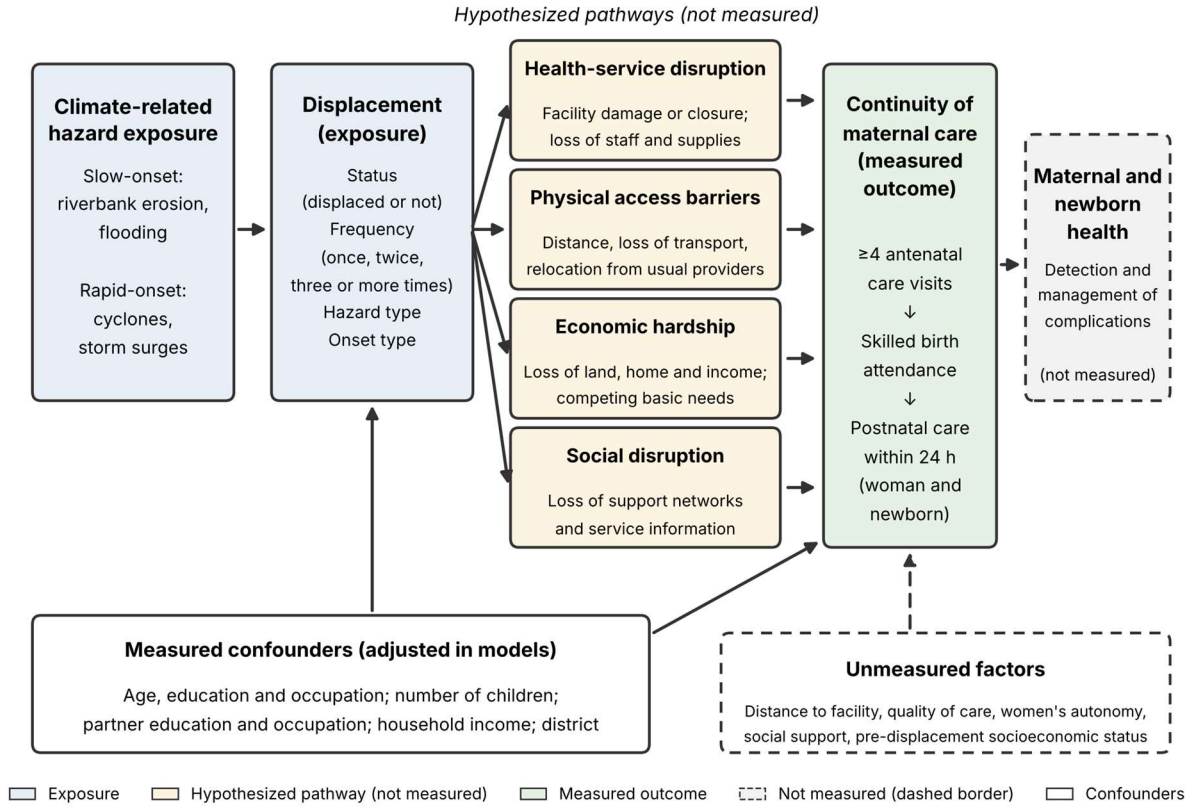
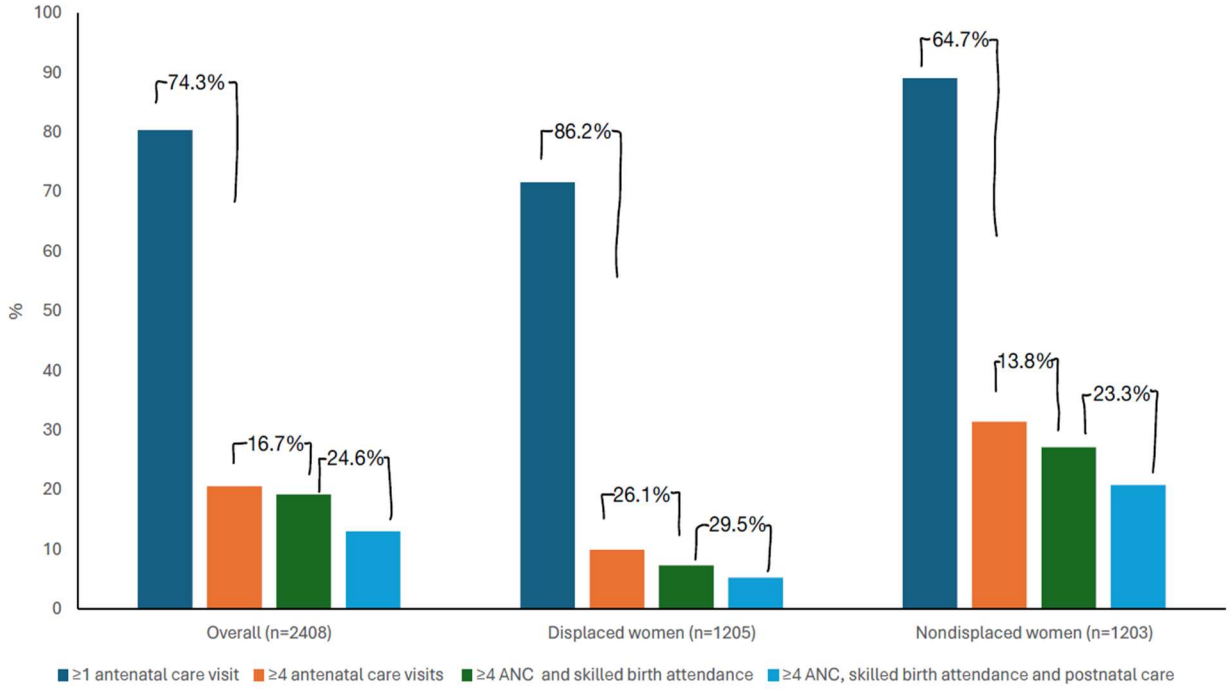


Fig. 2. **Drop-out between successive stages of maternal health care by displacement status, Bangladesh, 2023–2024**



Note: the values in the graphs show the percentages of women dropping out between each stage on the continuum of care.