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KNOWLEDGE FOR
GLOBAL LIFESAVING SOLUTIONS

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EXECUTIVE SUMMARY

Caesarean section (CS) can be a lifesaving operation when a woman or her baby faces complications before or during labor and delivery, and it is an essential intervention included in emergency obstetric care. The rate of caesarean delivery is increasing in countries worldwide, and Bangladesh is no exception. Between 1999 and 2010, the CS rate in Bangladesh increased from 0.7 percent to 12 percent, and in urban areas the rate is almost 16%. While the increase in CS suggests increased access to life-saving emergency obstetric care for more women in Bangladesh, it also brings with it the potential for several unintended consequences that require better understanding. BRAC's community based maternal and child health program, known as *Manoshi*, aims at reducing maternal and child mortality and illness in urban slums of Bangladesh. *Manoshi* uses its' delivery centres throughout the urban slums for normal safe delivery and it refers complicated cases to referral facilities. Data provided by Manoshi program personnel indicate that 53% of women who delivered in the hospital and 23% of all women in the Manoshi program in Dhaka city underwent CS delivery in 2010.

This study documented several causes and consequences of caesarean deliveries in the urban slums of Dhaka City. The specific study aims were to document the supply and demand side factors associated with CS; document the short-term medical, economic, and social consequences of CS for women and their families; and to document the cost of CS to the *Manoshi* program and to CS recipients and their households. This was an observational, survey- and record review-based, mixed retrospective/prospective classical case-control design using women who underwent cesarean section (CS) delivery as cases and normal vaginal delivery (NVD) as controls. Data collection was carried out in two phases; in the first phase data was collected from May to October 2011 at the facility level and second phase data collection was carried out between July and December 2011 in the community level. A total of 732 women (n=342 in control and n= 390 in the case groups) were interviewed in the facility and among them 669 women were successfully followed up in Phase 2 data collection at the community level. Women were selected from six purposively selected facilities that included public sector, private not-for-profit, and private for-profit facilities. Descriptive and multivariate analyses were done to interpret the study findings.

The mean age of participants was 24 years and the mean age at first pregnancy for NVD group and CS group were 18.8 years and 19.2 years respectively, with 10%

(NVD) and 8% (CS) respondents reporting first pregnancy at 15 years or younger. The rate of preterm birth (< 37 weeks GA) was 8.5% in the NVD control group and 4.6% in the CS case group. About 67% of respondents were from public facility and 30% from private not-for-profit facilities while only 3% were from private for-profit facility.

Almost one-half of the women reported no pregnancy-specific antepartum complications. CS cases were more likely than NVD controls to have experienced severe headache and blurring of vision (OR=1.84, 95% CI [1.04-3.26]). The most common reason for referral by *Manoshi* was prolonged labour (36%), followed by premature rupture of membranes after 37 weeks gestational age before labour onset (12%), previous CS (10%), malpresentation (7%), postdate (6%), and pre-eclampsia or pre-eclampsia-like symptoms (5%) where the most common intrapartum complications reported by the women were prolonged labour (23%), and high blood pressure (7%). From the medical record review, the most common indications for CS were documented as: fetal distress (38%), previous CS (20%), postdate (18%), oligohydramnios (14%), malpresentation (11%), prolonged labour (8%), and obstructed labour (7%).

Among women who were indicated as "postdate" in either the referral indication and/or the CS indication, slightly more than 80% were at a self-reported gestational age less than 42 weeks. Thirty-one percent (31%) of women were referred by BRAC for "prolonged labour" if 12 hours since their self-reported time of onset of labour pain had not yet elapsed. Seventy-seven percent (77%) of CS cases with previous CS, 51% with postdate, and 35% with pre-eclampsia included in documented medical indication for CS did not undergo any trial of labour (TOL) at terminal birth facility (TOL self-reported). Additionally, 70% of CS cases referred for prolonged labour, 73% referred for obstructed labour, 55% referred for fetal distress, and 50% with bleeding per vagina still underwent TOL after arriving at the facility, before CS. Seventy-three percent (73%) CS cases referred for previous CS, 37% referred for pre-eclampsia and 32% referred for "rupture of membranes" or PROM did not undergo any TOL before CS delivery.

Only 24% of women reported postpartum complications in hospital with severe lower abdominal pain (5%), excessive bleeding (4%), and convulsions or fits (4%) being the most common. CS cases were less likely to have experienced excessive bleeding (OR: 0.167, 95% CI [061-.456]), but more likely to have experienced coryza/cough (OR: 22.600, 95% CI [2.804-182.141]). The mean length of hospital stay for the NVD group was 31 hours (SD = 34hours) and for CS group was 101

hours (SD = 89 hours). The mean time to first breastfeeding for NVD group was 162 minutes (SD = 430, range 5 – 96 hours), and for CS group was 293 minutes (SD = 527, range 20 – 96 hours). CS cases were more likely to experience wound infection or possible wound infection symptoms than NVD controls [33% vs. 11%] (OR 3.78, 95%CI [2.51-5.72]) as postnatal complications at follow-up. CS cases were more likely than NVD controls to score "positive" for major depressive disorder screening, using the Edinburgh Postpartum Depression Scale and recent score criteria updates, during the in-hospital interview but not at the follow-up interview.

Cases and controls showed a similar mean birth weight for neonates (2.8 kg), but low birth weight status was more prevalent in NVD controls. CS case infants were more likely than NVD control infants to experience fever ≥ 37.5°C, but less likely to experience "absent cry" or "low birth weight" or failure to thrive. Apart from stillbirths, we found 16 neonatal deaths before (n=7) or after discharging (n=9) from the hospital.

More than 99% of women reported receiving antenatal care (ANC) with 96% attending 4 or more ANC visits. The majority (81%) of women wanted to have their delivery at a BRAC *Manoshi* delivery centre while 13% preferred at facility and 6% preferred at home. CS cases were more likely than NVD controls to have initially wanted to deliver at a hospital rather than home or BRAC delivery centre (OR 3.36, 95% CI [2.04-5.55]). Seventy-six percent of women were referred from the BRAC delivery centre itself; 94% of women were referred by direct observation and the most common (64%) referring personnel from BRAC was *Shasthya Karmi* (SK). Fifty-eight percent of women reported that doctors were the primary decision maker for their CS delivery.

Sixty-eight percent of women experienced normal labor pain before delivery while only 8% reported medicine-induced labour pain. About 9% of women underwent a trial of labor at home and 10% women visited a facility other than their terminal facility after leaving BRAC delivery centre. CS cases were more likely than NVD controls (22% vs 12%) to have spent 16 hours or more at home if they did not go to BRAC delivery centre. Forty percent of women spent less than an hour and 13% women spent more than 2 hours in transportation from home or BRAC to reach the terminal facility, if they did not visit another facility. Twenty-five percent of NVDs and 20% of CS cases had spent 8 to16 hours in BRAC delivery centre. In 24% of NVD controls and 36% of CS cases, 4 to 8 hours elapsed before their delivery in terminal facility. Seventy-six percent of CS cases who self-reported that they did

not undergo any trial of labour at the terminal facility did not deliver within 2 hours of arrival at the facility.

Regarding cost of delivery at referral facilities, the highest costs (15,980 BDT) were incurred in private for-profit facilities, followed by NGO-not for-profit (9,410 BDT) and public facilities (7,775 BDT). Costs in private facility for normal delivery were 3.2 times higher than the public facility. Multiple sources of funding were reported, the highest being household income (78%) followed by borrowing (69%), *Manoshi* help (63%). The proportion of costs shared by each of these mechanisms was 39%, 42% and 14% respectively. *Manoshi* shared highest proportion of cost in public facilities (11%) followed by NGO (6.5%) and private facilities (1.3%). Households had to adopt several mechanisms at follow-up to cope up with the delivery or post delivery expenditure and among the mechanisms significantly higher proportion were: selling or mortgaging household assets (p=0.005), borrowing money (p=0.001), postponing previous loan payment (p=0.032), decreasing recreational costs (p=0.026), purchasing fewer necessary household materials (p=0.018), and delaying or never seeking healthcare (p=0.019). Ten percent of families scored as having "moderate household hunger" or "severe household hunger" on the Household Hunger Scale.

At follow-up interview, 12% percent of CS cases and 10% of NVD controls reported their family status as "low" or "very low", and 15% of CS cases and 11% of NVD controls reported a worsening in their relationship with husbands since before delivery. The most common behaviors of domestic abuse and neglect reported by women were: verbal abuse (21%); lack of emotional support (14%); lack of physical support (14%); and physical violence (9%). A total of 31% of CS cases and 27% of NVD controls reported at least one of the listed behaviors of abuse/neglect by their husband since delivery, the majority of whom reported that these behaviours had increased in frequency since before delivery. In addition, a total of 14% of both CS cases and NVD controls reported at least one of the listed behaviors of abuse or neglect by family members other than their husband since delivery.

This study demonstrates the medical care and consequences, economic consequences, and social consequences of NVD and CS in facilities after referral by BRAC *Manoshi* programme. The findings suggest the following recommendations for the *Manoshi* program. It should continue its efforts to promote frequent antenatal visits; ensure women have documentation of LMP and EDD as accurately as possible; encourage women not to trial or delay at home;

ensure adequate training for *Manoshi* staff to appropriately refer women for more common problems; seek to deter the need for families to take drastic measures to financially cope with delivery costs; make women aware about the increased risks associated with CS, especially those who have intention of doing caesarean delivery or delivering at a hospital; consider addressing the high positive screening rates of postpartum depression and thoughts of self-harm in postpartum women; and consider programmatic interventions (e.g. promoting family members' awareness) to deter and prevent abusive and neglectful behaviours towards women in the postpartum period.

INTRODUCTION

The United Nations' Millennium Development Goals 4 and 5 (MDG 4 and 5) call for countries to "reduce by two thirds, between 1990 and 2015, the under-five mortality rate" and "reduce by three quarters, between 1990 and 2015, the maternal mortality ratio", respectively[1]. Since the creation of the MDGs, Bangladesh has seen substantial reductions in both its maternal mortality ratio (MMR) and under-5 mortality ratio. However, improvements in maternal and neonatal health, and obstetric care are still necessary to achieve the MDG goals by 2015.

One vital component of life-saving emergency obstetric care is cesarean section (CS) delivery, the surgical delivery of a fetus through incision in the maternal abdominal and uterine walls. CS is performed to prevent or address impending morbidity and mortality from maternal and/or fetal complications during pregnancy and/or delivery. Unpublished data from the Centre for Reproductive Health at Icddr,b have characterized the following common medical indications for CS in rural northern Bangladesh: malpresentation (25%), fetal distress (19%), previous CS (17%), eclampsia (7%), premature rupture of membrane (7%), post-term/ postdate (5%), failed induction of labor (2%), and others (18%). However, the common indications for CS in the hospitals serving the urban slums of Bangladesh are unknown.

The proportion of deliveries by CS has been increasing worldwide for decades, owing to a multitude of reasons, including increased access to technology and care, maternal request, defensive obstetrics, and hesitancy to undergo vaginal birth after CS[2-4]. The rising rates prompted World Health Organization (WHO) in 1985

to state: "There is no justification for any region to have a [CS] rate higher than 10-15%"[5]. In Bangladesh, the CS rate increased from 2.7% to 12.2% between 2001-2010. However, data from the recent Bangladesh Maternal Mortality Survey (2010) show that among births occurring in facilities, more than one-half are by CS, and the CS rate reaches 71% for births occurring in private facilities[6]. Data from BMMS 2010 also shows that the CS rate is higher in urban (15.9%) than rural areas (5.4%)[6].

As an abdominal surgical operation, CS carries many risks. Using data from the WHO Global Survey on Maternal and Perinatal Health 2007-2008, two separate studies using data from Asia have demonstrated a significant increase in serious, short-term adverse medical outcomes when CS is performed. They discovered a greater than five-fold increased odds of adverse events using the maternal mortality and morbidity index—maternal death, admission to ICU, or need for blood transfusion, internal iliac ligation, or hysterectomy[7-8]. Both of these studies also found that CS *without medical indication* displayed *even greater odds* of serious adverse events compared to normal vaginal delivery (NVD). Thus, CS is an increasingly common intervention, but with increased morbidity and mortality for both mother and child, particularly when performed without medical indication. In Bangladesh, 9.4% of women who reported no complications in pregnancy or delivery underwent CS[6]. The rate and occurrence of adverse events for both mother and neonate in the hospitals serving the slums of urban Bangladesh are unknown.

As previously mentioned, high rates of CS in Bangladesh are especially noticeable in the private facilities[6] which raises concerns regarding catastrophic health expenditures and access for the poor. In two representative districts of Bangladesh in 2009-2010, total medical consumer costs – or "out-of-pocket" expenditures – were greater for CS delivery than NVD. Notably, the difference varied by facility type, with a 1.1-to-2.5-fold increase in public facilities, 3.4-to-4.0-fold increase in NGO for-profit facilities, and an 8.8-fold increase in NGO not-for-profit facilities. Any delivery complications, such as post-partum haemorrhage and eclampsia, further increased medical consumer costs by 720-6,250 BDT (PPH) and 489-15,000 BDT (eclampsia), again with higher increases in private facilities. The average additional non-medical consumer costs (travel, food, companion expenditures, etc.) for all facilities were 1,654 – 2,059 BDT[9]. A single-facility study in urban Bangladesh by Alamgir et al. in 2010 showed that a mean health expenditure of 94 USD (7050 BDT) for hospitalization of one child with pneumonia was often financially catastrophic for families, requiring these families to borrow, mortgage or sell assets (76%), work extra hours (22%) and/or reduce spending on food and

education for their children (50%)[10]. Thus, examining the costing, payment sources and economic coping mechanisms of CS in the urban slums of Bangladesh is also warranted.

The rate of postpartum depression at 6-8 weeks after delivery in rural Bangladesh has previously been reported as 22%. Among the risk factors identified were a poor relationship with the mother's mother-in-law and either the mother or her husband leaving home after a dispute[11]. Regarding antepartum depression, a history of physical intimate partner violence had the strongest association for antepartum depression (at 34-35 weeks) among rural Bangladeshi women; additionally, 14% of the depressed women admitted to thoughts of self-harm during the pregnancy[12]. Thus, the prevalences of postpartum depression, thoughts of self-harm, and abuse and neglect in the slums of urban Bangladesh thus require further investigation.

Very few studies have investigated a link between CS delivery and abuse or neglect towards the mother from an intimate partner or her family. In low-income African American women in the United States in 2001-2003, Subramanian et al found no association between CS delivery and the occurrence of intimate partner violence[13].

In 2008, more than one-third (3 million) of the 9 million population in Dhaka, Bangladesh's capital city lived in urban slums. The slum dwelling population in the Dhaka slums increases at a rapid rate (7% per annum), with a doubling period of only 10 years; three-fourths of the new population in Dhaka every year are in the slums[14]. BRAC is a Bangladeshi non-governmental organization with multi-faceted programs to "empower people and communities in situations of poverty, illiteracy, disease and social injustice" [15]. In 2007, with funding from the Gates Foundation, BRAC began the *Manoshi* program, a comprehensive, community-based effort to "ensure safe motherhood by way of safe delivery and newborn and child care" in the urban slums of Dhaka. Scale-up aims to extend to all slum areas by the end of 2011 [16]. icddr,b strategically partners with *Manoshi* for research and evaluation of the program. This provides a unique opportunity to study the experience of CS for a significant and increasing proportion of the population for which little data exists on the subject, and where an active MNCH intervention has been in place for several years.

Data provided by *Manoshi* program personnel indicate that among women who delivered in the hospital (75% of whom were referred directly by *Manoshi* program personnel), 53% underwent CS in 2010. These data also indicate that 23% percent

of all women in the *Manoshi* program in Dhaka city underwent CS delivery. These rates are 3.3-fold (referred women) and 1.4-fold (all women) greater than the aforementioned rate of CS in urban Bangladesh (15.9%). The medical, social, and economic causes and consequences of CS for these women are largely unknown. In light of these considerations, a study involving *Manoshi* intervention areas aimed to provide critical information on the medical, social, and economic factors and consequences of CS in the urban slums of Dhaka. The results can inform BRAC and *Manoshi* program policies and strategies, other health and development organizations, the medical community, and the Government of Bangladesh to continue progressing towards achieving MDG 4 and 5 in Bangladesh by 2015.

This report presents the results of this study. It is organized in the following sections: first, the main objectives, details of study design, and methodology are presented. Next, the report describes the short- and long-term medical consequences of CS, followed by the care-seeking behaviours and courses of care for women. Finally, we present the economic and social consequences of CS. Supply and demand factors for CS are not delineated specifically, but are addressed throughout the results and in the discussion and conclusion.

OBJECTIVES

Overall Objective

Document the causes and consequences of CS deliveries in the slums of Dhaka City Corporation.

Specific objectives

- Document the supply and demand side factors associated with CS.
- Document the short-term medical, economic, and social consequences of CS for women and their families.
- Document the cost of CS to the *Manoshi* program and to CS recipients and their households.

METHODOLOGY

Design and enrollment

This study was an observational, survey- and record review-based, mixed retrospective/prospective classical case-control design using women who underwent cesarean section (CS) delivery as cases and normal vaginal delivery (NVD) as controls.

Selection of facilities

Prior to data collection, we performed a mapping of the facilities to which the *Manoshi* program refers delivery cases. We collected information on the number of referral cases (including self-referred cases) and modes of delivery in the last three months at all 35 BRAC *Manoshi* branch offices located in Dhaka. The comprehensive list included 76 referral facilities and included public, non-governmental (NGO) not-for-profit, and NGO for-profit hospitals. We purposively selected 3 facilities of each type (Public, NGO not-for-profit and NGO for-profit) based on the highest number of referral cases in each facility category. Our targeted sample was intended to be proportional to the actual referral frequency to each of the 9 facilities in the last 3 months. However, after starting data collection, we discovered *Manoshi* was not directly referring women to three of our selected facilities (1 public and 2 NGO for-profit), so we only collected information from 6 facilities. The final 6 facilities included were: Dhaka Medical College and Hospital (DMCH); Sir Salimullah Medical College (public), RH STEP, UTPS and Shimantik (NGO not for-profit) and Patient Care (NGO, for-profit). Table 1 presents the inclusion and exclusion criteria for participants in the study.

Sample size calculation

Since there was no Bangladesh-specific data available for many of the medical outcomes inquired about here, an arbitrary 50% was used as the proportion for outcome variables, with a power of 0.8, precision of the estimate as 0.05, and α=0.05 for the normal deviation. The target sample size was calculated to be 384 cases for each of the case (CS) and control (NVD) groups; anticipating a dropout rate of 10%, 427 enrollees became the targeted number of enrollees for each group.

We also sought to detect risk factors associated with CS delivery in our hospital-based referral population. Assuming that within this population, prolonged labour increases risk of CS as opposed to NVD by 100% (odds ratio = 2) and that the prevalence of prolonged labour in the NVD control group was 10%, we determined that the study would need 307 subjects in each case and control group.

At completion of the study, a total of 732 women were initially enrolled (390 CS cases and 342 NVD controls), and 669 women completed follow-up interview (352 CS cases and 317 NVD controls).

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
• Females 11-64 years of age	ANYTIME • Declined or withdrew participation
• Delivered baby (live or stillborn) during current stay in the healthcare facility where interview took place	PHASE 1 • Intent to leave *Manoshi* area within 2 months of initial interview
• Referred directly to facility by *Manoshi* health worker by direct observation or telephone	• Triplet or greater gestation • Discharged from hospital before completion of Phase 1 interview
• Current or permanent address within *Manoshi* intervention area, where intervention has been present for at least 2 years	PHASE 2 • Lost to follow-up • Could not be located • Otherwise unable to complete follow-up interview

Data collection

Data collection was carried out from May – October 2011 (for Phase 1) and July - December 2011 (for Phase 2). Seven trained Icddr,b field staff performed interviews in two phases: Phase 1 was during the immediate post-partum, in-patient period and no more than 72 hours after delivery; and Phase 2 was at least six weeks after discharge and took place in the community setting.

Phase 1

During Phase 1, we reviewed medical records for normal and caesarean delivery, and collected information on household assets and socio-demographic information;

antenatal care-seeking behavior; expenditure for delivery; cost assistance provided by *Manoshi*; information about members who accompanied the woman to health facility and/or who stayed with the woman at the health facility; time involvement of *Manoshi* staff in referral management, transport management, receiving women at the health facility, and staying at facility with the referred women; and the Edinburgh Postpartum Depression Scale (EPDS) survey[17]. Field staff also transcribed the indication for referral given on *Manoshi* documentation and, for women undergoing CS, the documented indication(s) for CS from the medical record. Additionally, field staff collected last menstrual period (LMP) and estimated date of delivery (EDD) from the *Manoshi* referral form or ultrasound report when the mother was unable to answer. A study physician not involved in the patient's care reviewed the transcribed indications for CS for categorization for quantitative analysis.

Phase 2

During Phase 2, the same women in Phase 1 were interviewed in the community setting using a different survey which asked about: household assets and other socio-economic information; neonatal and postnatal complications and care seeking behaviors; current health status of the women and her baby; expenditures and coping mechanisms for the mother and her child; relationships of women after delivery with their husband, family members and neighbors; 9-item Household Food Insecurity Access Scale (HFIAS)[18]; health utility index and activities of daily living; and a repeat of the EPDS. The women were interviewed at least six weeks after hospital discharge (actual mean 8 2/7 weeks, SD=18 days). A total of n=317 women in the control group (NVD) and n=352 in the CS case group completed Phase 2 follow-up interview. Reasons for exclusion and loss to follow-up are discussed in results.

Data management and analysis

Data Entry

Single data entry was performed in Oracle database software and exported in appropriate formats for statistical analysis packages. Investigators identified missing or aberrant responses and revalidation for accuracy with paper files was then performed. When data aberrancy was irresolvable or truly missing, the values were excluded and the final analysis sample size was reported in the results section.

Free-form response categorization

Free-form survey responses were reviewed and post-coded by a study physician (author JF) for inclusion in quantitative analysis. These are reported in the "results" section. When necessary, this study physician consulted a Gynecologist and Obstetrician (Dr. Farzana Sharmin, Junior Consultant, Bangladesh Institute Health Science) to clarify medical terminology found in the documentation or to determine when responses could be categorized as one complication (e.g. "blurring of vision and headache" and "pregnancy-induced hyptertension" as "preeclampsia and preeclampsia-like symptoms"). Symptoms or conditions which were low in frequency, or which the study physician regarded as minor complaints, were included in the "other(s)" category. These are specifically described as follows:

For self-reported antenatal complications, we post-coded weakness, common cold/cough, and urinary tract infection. Included as "others" because of low frequency were hormonal problems (n=1), previous scar tenderness (n=2), malpresentation (n=1), chicken pox (n=3), and oral ulcer (n=3). Backache (n=9) was coded as "other(s)" as the study physician regarded it as a minor complaint.

For self-reported antepartum medical comorbidities, included as "other(s)" for low frequency were uterine or breast tumor (n=2), piles (n=1), rheumatic fever (n=2), liver disease or hepatitis (n=2), gallstone (n=1), and bony growth on back (n=2).

For self-reported intra-partum complications, we post-coded oligohydramnios, fetal distress, placenta previa/low lying placenta, HBsAg positive, and labour dystocia/inability to bear down. Included as "other(s)" because of their low frequency were polyhydramnios (n=3), large for gestational age (n=3), perineal tear (n=2), twin pregnancy (n=1), no labour pain (n=2), scar tenderness (n=1), vaginal swelling (n=1), haematemesis (n=1), vertigo (n=1), uterine prolapse (n=1), postdated (n=1), and shivering (n=1). The following complaints were recoded as "preeclampsia or preeclampsia-like symptoms": generalized edema, blurring vision, headache, high blood pressure previously absent. Cord prolapse and presentation of any foetal part other than the head were coded as malpresentation.

For the reasons for referral provided by the *Manoshi* program, we post-coded the following: "rupture of membranes"/premature rupture of membranes, fever with headache, placenta previa, Rh-negative maternal blood type, HBsAg-

positive, "bad obstetric history", and labour dystocia/inability to bear down. Included as "others" were previous history of episiotomy (n=6), elder age (n=5), twin pregnancy (n=5), uterine tumor or polyp (n=5), prior gynecologic surgery or perineal tear (n=4), early primigravid (n=4), short stature (n=4), maternal request (n=3), respiratory distress (n=3), intrauterine growth retardation (n=3), polyhydramnios (n=2), vomiting/vertigo/haematemesis (n=2), uterine prolapse (n=2), GDM (n=1), hormonal problem (n=1), heart disease (n=1), kidney disease (n=1), diarrhoea (n=1), anaemia (n=1), multigravida (n=1), previous abdominal surgical history due to appendicitis.

For the indications for CS, we post-coded the following: "rupture of membranes"/premature rupture of membranes, fever with headache, placenta previa, Rh-negative maternal blood type, HBsAg-positive, "bad obstetric history", contracted pelvis, and elective CS or maternal request. Included as "other(s)" because of their low frequency are (n=4), history of home trial or BRAC delivery centre trial (n=4), previous history of gynecologic surgery (n=3), twin pregnancy with single fetus demise (n=2), urinary tract infection (n=2), gestational diabetes mellitus (n=1), intra uterine growth restriction (n=1), short stature (n=1), uterine fibroid with umbilical and abdominal hernia (n=1) and dilated cardiomyopathy (n=1). "Scar tenderness" and "impending rupture" were recoded as "previous CS" as these reflect one of the major intra-partum clinical concerns (uterine rupture) of women who have had a prior CS.

For maternal postpartum complications we post-coded the following: weakness, coryza/cough, and body ache/headache. Included as "other(s)" because of their low frequency were perineal tear (n=1), uterine infection (n=1), vaginal swelling (n=1), inverted nipple (n=1), diabetes (n=1), gastric ulcer or jaundice (n=6), and previous scar tenderness (n=2). Headache/vertigo (n=15) was coded as "other(s)", as the study physician regarded it as a minor complaint.

For neonatal complications, we post-coded only low birth weight. Meconium aspiration was recoded to be included with birth asphyxia. Included as "other(s)" were heamatoma (n=1) and oedema (n=1). "Absent defecation or micturition" (n=10) was included as "other(s)" because reports from the field staff indicate that most of these women were interviewed early after birth and before the neonate would be expected to defecate or urinate. Coryza/cough (n=8) was included as "other(s)", as the study physician considered it a minor complaint.

Exclusions

As previously mentioned, 669 of the total sample of 732 women were included for analysis from follow-up interview. Of the excluded women, 58 were not found in previously given address, 4 refused to complete the interview, and 1 declined or withdrew during the interview.

We talked with respondents or their neighbors or relatives to identify the reasons for unsuccessful follow-up interviews. The reasons reported by field staff are as follows: went back to native village (e.g., due to financial crisis, lack of manpower for child rearing, to see sick family member, and other unspecified reasons), migrated to another slum, migrated to another district for employment, came for short time to take advantage of *Manoshi* services then returned to native home, fell into debt and ran away to another place, and got divorced and moved to native home. Women who refused to give interview often expressed that they did not get any financial support from BRAC-*Manoshi* and were thus not interested to give any more time for the study.

Women who met Phase 2 follow-up exclusion criteria were compared with those who completed follow-up. The only identified difference in basic socioeconomic indicators and medical characteristics (age at first pregnancy, *gravida, para*) was respondents' occupation, with the exclusion population more likely to be non-government service worker or other, and less likely to be housewife or in business ($p=0.029$). The exclusions are reflected in reported analyses, however these women were included in analysis from Phase 1 interviews.

For twin or greater multiple pregnancies (2% of study population), data was entered for only one child, and reflected in the analysis specific to neonates. For all neonatal outcomes, only live births were considered. Other reductions in sample size due to exclusions are found in the reported results.

Scoring systems

We used the validated postpartum depression screening tool (EPDS) and scoring cutoffs proposed by Cox et al [17] as well as score cutoffs recently proposed by Chaudron et al [19]. In brief, the EPDS is used to screen for minor depressive disorder (MnDD) and major depressive disorder (MDD). Cutoff scores of ≥ 7 and ≥ 9 (Chaudron et al cutoffs for MnDD and MDD, respectively) and ≥ 10 and ≥ 13

(Cox criteria for MnDD and MDD, respectively), or if a woman had any response different than "never" regarding thoughts of self-harm, were chosen as a "positive screen". The Chaudron et al cutoffs are included because they were validated among women from lower socioeconomic class, a major socioeconomic feature of our urban slum population.

Food insecurity measures were collected using the Household Food Insecurity Access Scale, a 9-question ordinal scale in which mothers considered the last 30 days. Scores are reported categorically by original 9 items, 4 frequency HFIAS criteria or by updated and revised 3 items, 3 frequency Household Hunger Scale (HHS) categories which use the same administered survey[18, 20].

Descriptive and multivariate analysis

Descriptive analysis was performed for cases and controls. χ^2 tests were used to determine significant categorical relationships, z-tests for bivariate proportions, and Pearson's t-test for continuous variables. Differences were considered statistically significant if $\alpha \leq 0.05$ or if 95% CI did not include 1.

Multiple logistic regression was used to determine odds ratios and 95% confidence intervals where significant z scores were included, and CS or NVD was used as a covariate. Data analysis was completed using SPSS (rel 17.0.0, 2008, Chicago: SPSS Inc.) and STATA (11.1; 2009).

Economic and costing analysis

In this study, incidence based approach is used to estimate the cost-of-illness (COI) for delivery cases which have been referred by *Manoshi*. The incidence-based approach estimates lifetime costs by measuring the costs of an illness from onset to end for the cases beginning within the study period (Hodgson, 1988). In this study, COI for delivery care (referred by *Manoshi*) is captured in three stages, namely, 'before referring', 'during treatment' and 'after discharge from the facility up to 42 days'.

Cost components

The cost contains both "direct cost items" and "indirect cost items"[21]. Direct cost items include travel cost to and from facility, admission fee, diagnosis cost, medication cost, surgical cost, hospital bed charge, food cost, treatment cost of

newborn, time price of BRAC staff (SS, SK, and MMW) etc. Indirect cost items include productivity loss of mothers' and attendants' time. These opportunity costs are estimated by the human capital approach[22]. The human capital approach measures the loss of production, like earnings loss, of a patient or caregiver. The human capital approach also includes the value of household work, usually valued as the opportunity cost of hiring a replacement from the labor market[23-24]. Productivity loss of mothers and caregivers are estimated using information of their monthly salary and time involved during delivery care.

Data collection on cost items

Considering the health condition of the mothers, *Manoshi* refers them to healthcare facilities which can provide services to complicated patients. *Manoshi* referral facilities include public, private and NGO hospitals/clinics or health centers on the basis of availability in the catchment area. Patients' self-reported costs for delivery care are taken for this study. Cost data is collected in two phases. In Phase 1, data on costs that have been incurred before delivery and during stay in delivery facility has been taken from the patients. In Phase 2 (after 42 days of delivery), data on cost of complication after delivery has been taken as follow up period at their residence.

Ethical considerations

Field staff obtained written informed consent from eligible study participants before initiating the survey. Risks for study participants were minimal, as this was an observational, survey-based study. Women did not receive monetary or material compensation for participation and each participant was assured that study participation or declination would not affect their ability to access *Manoshi*, BRAC, or icddr,b services. Women who indicated any thoughts of self-harm during the interview or on the final question of the EPDS were referred to the Department of Mental Health of Dhaka Medical College hospital. This study was approved by the icddr,b Research Review Committee (RRC) and Ethical Review Committee (ERC) on 5 April 2011.

RESULTS

Study population

We enrolled a total of 732 women in the study; n=342 in the control or normal vaginal delivery (NVD) group and n=390 in the case or cesarean section delivery (CS) group. Women who delivered vaginally both without episiotomy (33%, n=112) and with episiotomy (67%, n=230) were included in the NVD group. No women in this group or our study reported undergoing "assisted vaginal delivery."

Socioeconomic status

Basic socioeconomic indicators are given in Table 2. The mean household income for respondents was 12,385 BDT (165 USD) per month (SD=8,830, range 1,500-78,333). The mean self-generated income was 579 BDT (8 USD) per month (SD=1,939, range 0-30,000) with 84% of women reporting no self-generated income. The majority of respondents reported their households having functioning electricity (98%), mobile phone (85%), and television/computer (59%), while far fewer owned a functioning refrigerator (12%) or a means of self-transportation, either motorcycle, scooter, car, truck, van, or rickshaw (5.1%).

Only 8% of respondents reported completing secondary education (through Class 10), 58% reported completing primary education (through Class 5), and 19% reported no formal education. Regarding husband's educational status, 19% completed secondary, 66% completed primary school, and 21% had no formal education. A small minority of respondents (3%) and their husbands (3%) were educated in *madrasa*; the remaining went to secular schools and/or colleges.

Nearly all of the respondents were currently married (99%). Primary occupations included housewife (84%) and non-governmental service worker (10%), with small numbers working in housemaid service (1.6%), business (1.6%), and as daily wager (< 1%). No women reported working for government services. The most common occupation for husbands was non-government services (41%), business (18%), daily wager (16%), non-motorized transport worker (19%), and motorized transport worker (8.6%), with a small number employed in government services (1%), overseas labor/trade (1%), and farming (< 1%). Only 0.4% of respondents reported that their husbands were unemployed.

Medical characteristics

The mean age of participants was 24 years (SD=5, range 14-45), with 3% of women reporting age less than eighteen years and 4.4% reporting thirty-five years or older (Table 2). The mean ages at first pregnancy for NVD group and CS group were 18.8 years (SD=2.78, range 13-31) and 19.2 years (SD=2.72, range 13-29) respectively, with 10.2% (NVD) and 7.9% (CS) respondents reporting first pregnancy at 15 years or younger, including the most recent one.

Table 2. Basic socioeconomic characteristics

Variables		% collected during in-hospital interview (N=732)		
		NVD (%) (n=342)	CS (%) (n=390)	Total (%) (n=732)
Current age (years)	< 15	0.6	0.0	0.3
	15 – 17	3.2	2.8	3.0
	18 – 24	58.5	58.2	58.3
	25 – 34	32.7	35.1	34.0
	35+	5.0	3.8	4.4
Religion	Muslim	98.5	97.4	98.0
	Hindu	1.2	2.1	1.6
	Other (Christian, Buddhist, etc.)	0.3	0.5	0.4
Marital status	Currently married	98.0	99.2	98.6
	Divorced	0.0	0.3	0.1
	Separated	1.5	0.0	0.7
	Widowed	0.0	0.3	0.1
	Deserted	0.6	0.3	0.4
	Never married	0.0	0.0	0.0
Highest educational attainment (respondent)	No education	21.1	17.7	19.3
	Class 1-4 (Incomplete primary)	23.7	21.5	22.5
	Class 5 (Complete primary)	19.9	20.0	19.9
	Class 6-9 (Incomplete secondary)	27.8	32.8	30.5
	Class 10+ (Complete secondary or higher)	7.6	7.9	7.8
Type of education (respondent)	Not applicable	21.3	17.9	19.5
	School/college	75.4	79.0	77.3
	Madrasa (Islamic education)	3.2	3.1	3.1

Variables		% collected during in-hospital interview (N=732)		
		NVD (%) (n=342)	CS (%) (n=390)	Total (%) (n=732)
Highest educational attainment (husband)	No education	24.9	18.5	21.4
	Class 1-4 (Incomplete primary)	12.9	11.5	12.2
	Class 5 (Complete primary)	19.0	15.9	17.3
	Class 6-9 (Incomplete secondary)	26.0	33.6	30.1
	Class 10+ (Complete secondary and above)	16.4	19.2	17.9
	Unknown	0.9	1.3	1.1
Type of education (husband)	Not applicable	25.7	19.7	22.5
	School/college	73.1	76.4	74.9
	Madrasa (Islamic education)	1.2	3.8	2.6
Primary occupation (respondent)	Housewife	84.5	83.1	83.7
	Housemaid	2.6	0.8	1.6
	Business	1.2	2.1	1.6
	Government services	0.0	0.0	0.0
	Non-government services	9.4	10.8	10.1
	Daily wager	0.6	0.8	0.7
	Other(s)	1.8	2.6	2.2
Primary occupation (husband)	Farmer	0.3	0.5	0.4
	Daily wager	16.1	15.4	15.7
	Business	14.9	21.5	18.4
	Government services	1.8	0.5	1.1
	Non-government services	42.1	40.3	41.1
	Overseas job/trade	1.2	0.8	1.0
	Transport worker, motorized	9.4	7.9	8.6
	Transport worker, non-motorized	13.2	8.5	10.7
	Unemployed	0.0	0.8	0.4
	Other	0.9	3.1	2.0
	N/A	0.0	0.5	0.3
	Do not know	0.3	0.3	0.3

The mean *gravida* (G) was 2.21 for NVD (SD=1.5, range 1-9) and 2.10 for CS (SD=1.22, range 1-7). The mean *para* (P) was 1.91 for NVD (SD=1.23, range 1-7) and 1.75 for CS (range 1-6); higher parity for women receiving NVD was statistically significant. G1 or G2 women – including the most recent pregnancy

– composed 68% of NVD group and 70% of the CS group. P1 women composed 52% of NVD group and 53% of CS group.

Of the women who were able to report an EDD or LMP (n=685), the mean gestational age (GA) was 39.4 weeks (SD=2.08) for NVD group and 39.8 weeks (SD=1.76) for CS group when asked directly for EDD or otherwise obtained from available documentation. CS cases were more likely than NVD controls (p=.018) to have greater gestation. This was not significant (p=.053) when calculating EDD from women who were able to recall their LMP.

Table 3: Age at first pregnancy, gravida, and parity, N=732

		NVD (%) (n=342)	CS (%) (n=390)	Total (%)
Age at first pregnancy (years)	≤ 15	10.2	7.9	9.0
	16 – 19	54.7	55.6	55.2
	20+	35.1	36.4	35.8
Gravida	1	43.0	40.5	41.7
	2	24.6	29.2	27.0
	3-5	27.8	29.0	28.4
	6+	4.7	1.3	2.9
Para	1	52.3	52.6	52.5
	2	22.8	28.2	25.7
	3-5	22.8	19.0	20.8
	6+	2.0	0.3	1.1

Note: Gravida and para numbers include the most recent pregnancy.

The rate of preterm birth (<37 weeks GA) was 8.5% in the NVD control group and 4.6% in CS case group. The rate of post term birth (≥42 weeks GA) was 7.3% in NVD control group and 7.2% in CS case group (Table 4). CS cases were more likely than NVD controls to have delivered between 40 and 41 and 6/7 weeks GA (Table 5).

Notably, we found that 80% (n=589) of participants could report both EDD and LMP. However, 18% (n=131) could not recall their LMP, 8% (n=59) could not report their EDD or had no record with them at time of interview, and 6% (n=47) could not report or had no available record of both EDD and LMP.

Table 4: Gestational age at delivery, calculated from EDD and actual date/time of delivery

Gestational age (weeks)	NVD (%) (n=342)	CS (%) (n=390)	Total (%) (n=732)
< 37	8.5	4.6	6.4
37 - 39.9	43.3	40.3	41.7
40 - 41.9	31.0	41.5	36.6
42+	7.3	7.2	7.2

6.4% of CS cases and 9.9% of NVD controls could not report EDD.

Table 5: Relative odds of preterm, post term, and 40 - 42 weeks gestational age at delivery

Gestational age (weeks)	Odds Ratio (CS / NVD)	95% Confidence Interval
< 37	0.585	0.312 1.098
40 – 41 6/7	1.441	1.033 2.008
42+	1.056	0.589 1.894

Reference category is 37 – 39 (6/7) weeks.
GA is calculated from EDD and actual date/time of delivery.

Terminal birth facility types

The proportions of the type of facility in which women gave birth and where the enrollment and in-hospital interview was conducted (terminal birth facility) are shown in Table 6. NVD births were very uncommon in NGO for-profit facilities (12% of all private facility births in our population), and field staff reported great difficulty in finding NVD controls to enroll from private facilities.

Table 6: Terminal birth facilities and enrollment locations, by type, N=732

Type of hospital	NVD (%) (n=342)	CS (%) (n=390)	Total (%)
Public	72.2	61.8	66.7
Private, not for profit	26.9	32.3	29.8
Private, for profit	0.9	5.9	3.6

Medical care and consequences

Antepartum

The most common pregnancy-specific antepartum complications in the study population were severe abdominal pain (14%), swollen hands/feet/face (9%), severe headache and blurred vision (8%), pregnancy-induced hypertension (8%), severe vomiting (8%), decreased fetal movement (7%), fever ≥38°C for at least 3 days (6%), and severe anemia (5%); rarer complications are listed in Table 7. Almost half of the women reported "no pregnancy-specific ante-partum complications." CS cases were more likely than NVD controls to have experienced severe headache and blurring of vision (OR=1.84, 95% CI [1.04-3.26]).

Table 7: Self-reported pregnancy-specific ante-partum complications, N=732

Pregnancy-specific ante-partum complications	Mode of Delivery		Total (%)
	NVD (%) (n=342)	CS (%) (n=390)	
"No complications"	45.9	42.8	44.3
Severe abdominal pain	15.8	13.1	14.3
Swollen hands, feet, and face	7.3	10.5	9.0
Severe headache and blurring of vision	5.6	10.5	8.2
High blood pressure	7.0	8.7	7.9
Severe vomiting	5.6	9.5	7.7
Decreased fetal movement	8.8	5.6	7.1
Fever ≥ 39˚C for at least 3 days	6.7	5.6	6.1
Severe anemia	3.5	5.9	4.8
Bleeding per vagina	2.3	4.6	3.6
Jaundice	3.2	3.6	3.4
Weakness	4.1	2.3	3.1
Coryza/cough	2.9	2.3	2.6
PPROM (rupture of membranes before 37 weeks)	2.9	2.1	2.5
Convulsions or fits	1.5	1.3	1.4
Urinary tract infection	1.2	1.3	1.2
Rh incompatibility	1.5	0.8	1.1
Oligohydramnios	0.6	1.3	1.0
Uterine prolapsed	1.2	0.3	0.7
Inadequate first trimester weight gain	0.0	0.8	0.4
Other(s)	9.4	11.0	10.2

Responses are not mutually exclusive.

Other complications and medical co-morbidities were rare, with asthma or respiratory distress occurring in 2.5% of women; rarer complications are listed in Table 8. There was no difference demonstrated between CS cases and NVD controls.

Table 8: Other ante-partum medical complications and co-morbidities, N=732

Other ante-partum complications and co-morbidities	Mode of Delivery		Total (%) (n=732)
	NVD (%) (n=342)	CS (%) (n=390)	
"No complications"	93.6	93.3	93.4
Asthma and respiratory distress	3.2	1.8	2.5
Kidney disease	0.9	0.3	0.5
Diabetes mellitus	0.6	0.3	0.4
Heart disease	0.3	0.3	0.3
Hyperthyroidism	0.3	0.3	0.3
Tuberculosis	0.0	0.3	0.1
Other(s)	0.3	1.8	1.1
Don't know	0.0	0.3	0.1

Responses are not mutually exclusive.

Intrapartum complications and referral indications

The most common reason for referral to higher level facility, based on record review, was prolonged labour (36%), followed by premature rupture of membranes after 37 weeks gestational age before labour onset (PROM; 12%), previous CS (10%), mal-presentation (7%), postdate (6%), and pre-eclampsia or pre-eclampsia-like symptoms (5%); rarer causes are found in Table 9. CS cases were more likely than NVD controls to be referred for mal-presentation, previous CS delivery, postdate, and oligohydramnios (Table 10). Ninety-one percent of the women were able to provide a BRAC-*Manoshi* referral documentation during the interview for field staff to transcribe the referral indication; the remaining 9% were asked directly their reason for referral. Their responses are included in analysis here.

Table 9: Indications for referral to facility

Indications for referral to facility	NVD (%) (n=342)	CS (%) (n=390)	Total (%) (n=732)
No complication	0.6	0.3	0.4
Prolonged labour	45.6	27.7	36.1
Rupture of membranes before labour pain onset or PROM	12.9	10.3	11.5
Previous CS	0.9	18.2	10.1
Malpresentation	4.4	8.5	6.6
Postdate	2.9	8.2	5.7
Pre-eclampsia*	4.4	6.2	5.3
Fetal distress	2.9	5.1	4.1
Oligohydramnios	0.3	6.7	3.7
Obstructed labour	4.4	2.8	3.6
Bleeding per vagina	2.3	3.1	2.7
PPROM	2.6	1.5	2.0
Fever or headache	2.0	1.5	1.8
Rh (-) blood type	1.8	0.8	1.2
Dystocia/inability to bear down	2.3	0.0	1.1
HbSAg (+)	1.5	0.3	0.8
Placenta previa	0.3	1.0	0.7
Eclampsia or convulsion	0.3	0.8	0.5
"Bad obstetric history"	0.3	0.8	0.5
Failed induction	0.0	0.3	0.1
Other(s)	13.2	9.0	10.9

* Includes preeclampsia-like symptoms (generalized edema, blurring vision, headache, high blood pressure absent before pregnancy)

Responses are not mutually exclusive.

Referral indications were collected from BRAC record (91% of all cases); if unavailable, mother's response was used (9% of all cases).

Table 10: Relative odds for significant referral indications

Relative odds for referral indications	Odds Ratio (CS / NVD)	95% Confidence interval	
Malpresentation	2.666	1.384	5.135
Previous CS	29.535	9.090	95.961
Postdate	3.947	1.878	8.297
Prolonged labour	0.832	0.594	1.166
Oligohydramnios	31.237	4.188	233.018

Responses for multivariate analysis were selected if the univariate z-score was significant.

Table 11 shows, according to referral indication, whether CS cases reported undergoing an attempt for trial of labour at the terminal birth facility before CS delivery. Notably, 70% of CS cases referred for prolonged labour, 73% referred for obstructed labour, 55% referred for fetal distress, and 50% with bleeding per vagina still underwent trial of labour after arriving at the facility. Additionally, 73% of CS cases referred for previous CS, 37% referred for preeclampsia and 32% referred for "rupture of membranes" or PROM, did not report any trial of labour before CS delivery.

Table 11: Referral indications for CS cases and TOL for normal delivery at terminal facility, N = 390

Indication for referral	n	% of n who underwent TOL at terminal birth facility
"No complication"	1	100
Prolonged labour	108	70
Previous CS	71	27
"Rupture of membranes" or PROM	40	68
Malpresentation	33	33
Postdate	32	50
Oligohydramnios	26	42
Preeclampsia	24	63
Fetal distress	20	55
Bleeding per vagina	12	50
Obstructed labour	11	73
PPROM	6	67
Fever/headache	6	50
Placenta previa	4	0
Eclampsia or convulsion	3	67
Rh-negative mother	3	67
Bad obstetric history	3	67
Failed induction	1	100
HBsAg(+)	1	100
Labour dystocia/inability to bear down	0	0
Other(s)	35	54

Indication(s) are not mutually exclusive.

Attempt for trial of labour based on self-report to a yes / no question asking if "there was any attempt for normal delivery at this [terminal birth] facility".

Referral indications were collected from BRAC record (91% of all cases); if unavailable, mother's response was used (9% of all cases).

The most common intrapartum complications reported by mothers were prolonged labour (23%) and high blood pressure (7%); rarer complications are given in Table 12. Notably, 54% of women reported that they had no intrapartum complications. There were no significant differences between CS and NVD groups for self-reported intrapartum complications.

Table 12: Self-reported immediate antepartum or intrapartum complications

Complications	Percentage (%)		
	NVD (n=342)	CS (n=390)	Total (n=732)
No complications	52.6	55.1	54.0
Prolonged labour (> 12 hours)	26.3	20.0	23.0
High blood pressure	5.8	7.4	6.7
Fever (greater than 38^{o}C)	3.5	3.6	3.6
Obstructed labour	2.9	3.3	3.1
Non-cephalic presentation	2.0	3.	3.0
Convulsion or fit	1.8	3.1	2.5
Oligohydramnios	0.6	3.6	2.2
Diarrhoea or vomiting	0.9	1.8	1.4
Labour dystocia or "inability to bear down"	1.8	0.5	1.1
Pain and burning sensation during micturition	0.9	0.8	0.8
Fetal distress	0.3	1.3	0.8
Respiratory distress	0.6	0.8	0.7
Retained placenta	0.3	0.8	0.5
Placenta previa or low lying placenta	0.6	0.5	0.5
HBsAg positive	0.9	0.3	0.5
Severe chest pain and rapid breathing	0.0	0.0	0.0
Other(s)	1.5	3.3	2.5

Prolonged labour as a referral indication, and timings from labour onset to terminal facility arrival

Thirty-six percent of total study population were referred by BRAC for prolonged labour, so we sought to compare this referral reason with the calculated time from onset of labour pain to arrival at the terminal birth facility. We found that, among the women who experienced non-medicine-induced labour pain before delivery, 31% of women were referred by BRAC for "prolonged labour" when 12 hours had not yet elapsed since their self-reported time of onset of labour pain (Table 13).

CS Indications

As previously stated, 390 women in our study population were selected as CS cases. The most common indications for CS based on facility medical documentation were fetal distress (38%), previous CS (20%), postdate (18%), oligohydramnios (14%), malpresentation (11%), prolonged labour (8%), and obstructed labour (7%); rarer complications can be found in Table 14. These indications were not mutually exclusive, as 42% of the cases had two or more documented indications for CS delivery, and 9% had three or more.

Table 13: Comparison of prolonged labour as referral indication and elapsed time from onset of labour pain to arrival at terminal birth facility

Elapsed time	Referred for prolonged labour (%) (n=228)	Referred for reason other than prolonged (%) labour (n=267)
< 12 hours	31	62
≥ 12 hours	69	38

Table only includes women who experienced non-medicine-induced labour pain before delivery (n=495).

Table 14 also indicates whether women reported undergoing a trial of labour at the terminal facility, for each given indication. Notably, 77% of CS cases with previous CS included in indication, 51% with postdate included in indication, and 35% with preeclampsia included in indication did not undergo any TOL at terminal birth facility, according to mother's report.

Table 14: Indications for CS from medical documentation and self-reported TOL at terminal facility

Indication(s) on facility medical record	% of all CS cases (N=390)	n	% within each indication who reported undergoing a trial of labour at terminal facility
Fetal distress	37.7	147	62
Previous CS	19.5	76	23
Postdate	17.9	70	49
Oligohydramnios	14.4	56	41
Malpresentation	11.3	44	39
Prolonged labour	7.7	30	77
Obstructed labour	7.4	29	76
Failed induction	4.6	18	72

Indication(s) on facility medical record	% of all CS cases (N=390)	n	% within each indication who reported undergoing a trial of labour at terminal facility
Preeclampsia	4.4	17	65
PROM	4.1	16	75
PPROM	2.3	9	67
Bleeding per vagina	2.1	8	25
Contracted pelvis	2.1	8	75
Rh(-) maternal blood type	1.8	7	43
Bad obstetric history	1.5	6	50
Eclampsia or convulsion	1.3	5	60
Placenta previa	1.3	5	40
Elective CS/maternal request	1.0	4	50
Fever / headache	0.8	3	67
HBsAg(+)	0.8	3	67
No complications	0.0	0	0.0
Other(s)	8.7	34	68

Responses are not mutually exclusive.

Postdate as a referral and CS indication, and self-reported EDD

Women referred from BRAC for postdate (6% of total study population) were more likely to undergo CS, and "postdate" was commonly included in the CS indication (18% of all cases). We sought to compare the self-reported EDD with these instances.

From the 365 CS cases who could report EDD, 83% of the 69 women with "postdate" documented as part of the CS indication were at a self-reported gestational age less than 42 weeks after calculating with actual date/time of delivery. Of the women who had no other documented CS indication than "postdate", 8 (14%) underwent CS before 42 weeks gestational age (2% of all CS cases).

From the total study population, thirty-three women who were referred from BRAC for "postdate" were at a self-reported gestational age less than 42 weeks (81% of the 41 women referred for "postdate" who could report EDD or LMP). Twenty-five of these 33 women were from the CS cases (Table 15).

Table 15: Comparison of postdate as indication for referral and/or CS with gestational age from self-reported EDD

Gestational age (weeks)*	Referral by *Manoshi* (%) (n=41)	CS at terminal facility (%) (n=69)
< 37	0	0
37 - 39.9	7.1	7.2
40 - 41.9	74.3	75.4
42+	17.1	17.4

* Calculated from self-reported EDD and recorded date/time of delivery, where birth on EDD = 40 weeks GA.

Table only includes women who were able to report EDD.

Self-reported postpartum complications, in hospital

Postpartum complications in hospital were rare, with severe lower abdominal pain (5%), excessive bleeding (4%), and convulsions or fits (4%) being the most common among all women in our study participants; rarer complications can be found in Table 16. CS cases were more likely to have experienced coryza/cough, but less likely to have experienced excessive bleeding (Table 17). The majority of women reported no postpartum complications in the hospital (76%). Additionally, a large majority of women in the study population reported that they were healthy when discharged (95%); however, 5% reported that they were "discharged with complications."

Table 16: Self-reported postpartum complications prior to hospital discharge

Self-reported postpartum complications	Percentage (%)		
	NVD (n=342)	CS (n=390)	Total (n=732)
"No complications"	77.8	74.6	76.1
Severe lower abdominal pain	4.7	4.4	4.5
Excessive bleeding	6.7	1.5	4.0
Convulsions or fits	3.5	4.1	3.8
Generalized body aches or headache	2.3	4.9	3.7
Coryza/cough	0.3	4.6	2.6
Weakness	2.3	1.8	2.0
Pain and/or burning sensation during micturition	1.8	1.3	1.5
Wound infection	0.6	2.1	1.4

Self-reported postpartum complications	Percentage (%)		
	NVD (n=342)	CS (n=390)	Total (n=732)
Fever ≥ 3 days (≥ 38˚C)	1.2	1.0	1.1
Severe anemia	1.2	1.0	1.1
Respiratory distress	0.3	1.3	0.8
Foul smelling vaginal discharge	0.9	0.5	0.7
Diarrhoea and vomiting	0.6	0.5	0.5
Tender, swollen breast with redness	0.0	0.8	0.4
Passage of urine or stool per vagina	0.0	0.5	0.3
Severe chest pain and rapid breathing	0.3	0.3	0.3
Other(s)	3.8	1.8	2.7

Responses are not mutually exclusive.

Table 17: Relative odds for self-reported postpartum complications, in-hospital

Self-reported postpartum complications, in hospital	Odds Ratio (CS/NVD)	95% Confidence interval	
Excessive bleeding	0.167	0.061	0.458
Coryza/cough	22.600	2.804	182.141

Responses for multivariate analysis were selected if univariate z-score was significant.

The mean length of hospital stay for the control NVD group was 31 hours (SD = 34 hours, range 2.5 hours – 15 days) and for CS group was 101 hours (SD = 89 hours, range 23 hours – 48 days). Among NVD controls, 6% were discharged before 6 hours; 11.4% were discharged before 12 hours. Among CS cases, <1% were discharged before a full 24 hours and 20% were discharged before 3 days. A small number of women stayed in hospital for one week or more, 1.5% of NVD controls and 5.4% of CS cases (Table 18).

Table 18: Duration of hospital stay

Time (d hh:mm)	NVD (%) (n=342)	CS (%) (n=390)	Total (%) (N=732)
< 06:00	5.6	0.0	2.6
06:00 – 11:59	5.8	0.0	2.7
12:00 – 23:59	37.7	0.3	17.8
1 – 2.9 days	45.9	19.7	32.0
3 – 6.9 days	3.5	74.6	41.4
7+ days	1.5	5.4	3.6

The mean time to first breastfeeding for NVD group was 162 minutes (SD = 430, range 5 – 96 hours), and for CS group was 293 minutes (SD = 527, range 20 – 96 hours). The mean difference was 131 minutes (95% CI 61 – 202). Within the first postpartum hour, 29% of NVD women had breastfed, whereas only 5% of CS group women had breastfed. By the second hour, 72% of NVD women and 34% of CS group women had breastfed (Table 19).

Table 19: Time to initial breastfeeding

Time from delivery to initial breastfeed (minutes)	NVD (%) (n=323)	CS (%) (n=380)	Total (%)
< 15	1.5	0.5	1.0
15 – 29	4.0	0.3	2.0
30 – 59	23.8	4.5	13.4
60 – 119 (1-1.9 h)	42.7	28.4	35.0
120 – 239 (2-3.9 h)	18.9	32.9	26.5
240 – 479 (4-7.9 h)	6.2	21.1	14.2
480 – 959 (8-15.9 h)	1.5	8.4	5.3
960+ (16+ h)	1.2	3.9	2.7

Only includes mothers with live births who had undertaken the first breastfeed by time of interview. Twenty-one had "not yet breastfed" and 1 "did not know".

Self-reported postpartum complications, after hospital discharge

The most commonly reported post-discharge complications at 6-week follow-up were; wound infection or possible wound infection symptoms (23%; includes redness, swelling, pruritis, and/or increased discharge), fever ≥ 38°C for at least 3 days (10%) and severe lower abdominal pain (9%); rarer complications are found in Table 20. CS cases were more likely to experience wound infection or possible wound infection symptoms than NVD controls (OR 3.78, 95% CI [2.51-5.72]). We did not have any maternal deaths in our follow-up population.

Table 20: Self-reported postpartum complications, after hospital discharge

Self-reported postpartum complications, after hospital discharge	Percentage (%)		
	NVD (n=317)	CS (n=352)	Total (n=669)
"No complications"	60.9	46.3	53.2
Wound infection, redness, swelling, pruritis, and/or increased discharge	11.4	32.7	22.6
Fever for ≥ 3 days (≥ 38˚C)	9.1	11.4	10.3
Severe lower abdominal pain	7.9	9.9	9.0
Pain and/or burning during micturition	2.2	4.5	3.4
Excessive bleeding	4.4	2.3	3.3
Generalized body ache/headache	3.2	2.8	3.0
Weakness	3.2	1.7	2.4
Convulsion/fit	2.5	2.0	2.2
Diarrhea and/or vomiting	0.9	2.6	1.8
Tender, swollen breast with redness	1.3	1.7	1.5
Coryza/cough	0.9	1.1	1.0
Severe anemia	0.9	0.3	0.6
Respiratory distress	0.6	0.6	0.6
Foul smelling vaginal discharge	0.3	0.6	0.4
Severe chest pain and rapid breathing	0.9	0.0	0.4
Other(s)	6.6	4.0	5.2

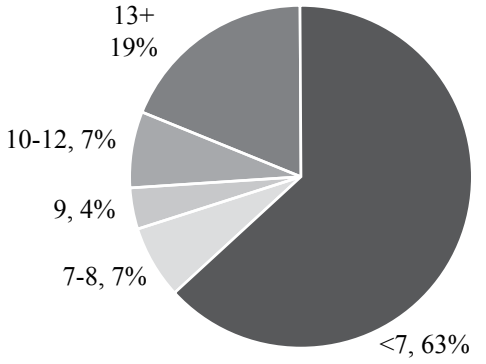
Responses are not mutually exclusive.

Postpartum depression screening

Edinburgh Postpartum Depression Scale (EPDS)

Edinburgh Postpartum Depression Scale (EPDS) scores at the in-hospital interviews and follow-up interviews are shown in Table 19. The overall rates of positive screens at 6 weeks were 21% (MnDD/MDD) and 12% (MDD) using Cox cutoff scores and 34% (MnDD/MDD) and 24% (MDD) using Chaudron cutoff scores (Figure 1). CS cases were more likely than NVD controls to score "positive" at the cutoffs of 9 for MDD during the in-hospital interview (Table 22). However, no significant difference between CS cases and NVD controls was identified from 6-week post-discharge interview EPDS scoring.

Figure 1: EPDS scores of study population at follow-up interview (n=669)



Key

< 7	negative score by all criteria
7-8	positive score for MnDD/MDD by Chaudron et al criteria
9	positive for MDD by Chaudron et al criteria
10-12	positive score for MDD by Chaudron et al., criteria, positive for MnDD/ MDD by Cox criteria.
13+	indicates positive score for MDD by both Chaudron and Cox criteria.

Scores here do not include an automatic "positive" category if the woman has any thoughts of self-harm.

Table 21: Positive EPDS screens in hospital and at follow-up interview

Positive EPDS screens in hospital (n=732) and at follow-up interview (n=669).

	Cutoff score	NVD (%)	CS (%)	Total (%)
In hospital (n=732)	7 (MnDD/MDD)	29.8	37.4	33.9
	9 (MDD)	20.5	27.7	24.3
	10 (MnDD/MDD)	18.7	23.8	21.4
	13 (MDD)	9.9	14.1	12.2
At follow-up interview (n=669)	7 (MnDD/MDD)	33.4	39.2	36.5
	9 (MDD)	27.4	32.4	30.0
	10 (MnDD/MDD)	24.6	28.1	26.5
	13 (MDD)	20.2	22.2	21.2

Any report of consideration of self-harm (score > 0 on EPDS question 10) whose numerical score fell in the lower category was re-categorized in the higher "positive" category.

MnDD = minor depressive disorder

MDD = major depressive disorder

Table 22: Odds ratios for positive EPDS screen, in hospital

Cutoff score	Odds ratio (CS / NVD)	95% Confidence interval
7 - 8	1.168	0.706 1.931
9 +	1.518	1.070 2.153

Reference category is < 7 (negative screen).
Any affirmative answer on EPDS question 10 regarding thoughts of self-harm were recategorized into the "9+" category (n=3 recategorized from score below 9).

Thoughts of self-harm

The final question on the EPDS asks the woman about thoughts of self-harm. In the hospital interview, 4% (n=15) of NVD controls and 6% (n=22) of CS cases reported at least some thoughts of self-harm in the last 7 days. These rates had both more than doubled at follow-up interview to 9% (n=28) in NVD controls and 12% (n=42) in CS cases. There was no difference found between CS cases and NVD controls. Additional results are given in Table 23.

Table 23: Thoughts of self-harm in hospital and at follow-up interview

Responses to EPDS question 10 regarding frequency of thoughts of self-harm in past 7 days, in hospital and at follow-up interview

	Response	NVD (%)	CS (%)	Total (%)
In hospital (NVD n=342, CS n=390)	Never	95.6	94.4	94.9
	Hardly ever	2.6	3.8	3.3
	Sometimes	1.8	1.5	1.6
	Often	0.0	0.3	0.1
Follow-up interview (NVD n=317, CS n=342)	Never	91.2	88.1	89.5
	Hardly ever	5.4	6.0	5.7
	Sometimes	3.5	5.4	4.5
	Often	0.0	0.6	0.3

Neonatal complications, in hospital

The overall study population had 96.4% singleton births (n=706) and 2.3% twin births (n=17) with 1.2% stillborn singleton births (n=9) and <1% mixed live/ stillborn twin births (n=3). Only live deliveries (n=723) are considered for further analysis of neonatal outcomes, with one child from each twin pair.

The mean birth weight for NVD group was 2.80 kg (SD=0.51, range 1.20-4.00) and for CS was 2.81 (SD=0.41, range 1.50-4.00). The rate of low birth weight

status (1.5 – 2.5 kg at delivery) was 12.5% in CS cases and 19% in NVD controls. Very low birth weight (< 1,500 g) and extremely low birth weight (< 1,000 g) were rare events, each <1% (Table 22).

Table 24: Neonatal birth weights

Birth weight (kg)	Categorization	NVD (%) (n=334)	CS (%) (n=384)	Total (%)
< 1.00	ELBW	0.0	0.3	0.1
1.00 - 1.49	VLBW	0.9	0.0	0.4
1.50 - 2.49	LBW	18.6	12.5	15.3
2.50+	Normal	80.5	87.2	84.1

ELBW = extremely low birth weight; VLBW = very low birth weight; LBW = low birth weight

The most common self-reported reported neonatal complications among live births were birth asphyxia (9%), fever ≥ 37.5°C (3%), neonatal jaundice (3%), low birth weight (3%), and absence of cry (3%); rarer complications can be found in Table 25. CS case infants were more likely than NVD control infants to experience fever ≥ 37.5°C, but less likely to experience "absent cry" or "low birth weight" (complication otherwise unspecified)/failure to thrive (Table 26). The majority of mothers (74%) reported "no complications" in their neonates during in-hospital interview. Additionally, 6% of women reported that their babies were "alive but sick" at discharge; the other 94% reported their neonate(s) were "alive and healthy" at discharge.

Table 25: Mother-reported neonatal complications, in hospital

	NVD (n=334)	CS (n=384)	Total
"No complications"	75.1	74.4	74.7
Birth asphyxia	11.2	7.8	9.4
Fever (>37.5˚C)	0.3	4.9	2.8
Jaundice	1.8	3.6	2.8
LBW / FTT	4.1	1.6	2.8
Absent cry	4.4	1.0	2.6
Birth injury	2.4	2.1	2.2
Decreased activity/lethargy	3.0	1.3	2.1
N/A	1.8	2.1	1.9
Eye infection	0.6	1.3	1.0
Convulsions or fits	0.6	0.8	0.7

	NVD (n=334)	CS (n=384)	Total
Unable to feed	0.0	1.0	0.6
Skin infection	0.0	1.0	0.6
Sever vomiting	0.6	0.5	0.6
Congenital anomalies	0.3	0.5	0.4
Pneumonia	0.3	0.3	0.3
Low body temperature (< 35.5˚C)	0.3	0.3	0.3
Umbilical infection	0.0	0.5	0.3
Other(s)	6.2	3.6	4.8

Responses are not mutually exclusive

Table 26: Relative odds for neonatal complications, in hospital

Relative odds for neonatal complications	Odds ratio (CS / NVD)	95% Confidence interval	
Fever (>37.5°C)	19.361	2.498	150.057
Absent cry	0.185	0.056	0.608
LBW/FTT	0.368	0.140	0.969

Responses included in multivariate analysis if univariate z-score was significant.

Neonatal outcomes, after hospital discharge

At follow-up, 97% (n=647) of the neonates were living, with 7 additional infant deaths after discharge. Only living infants are considered for further analysis. The most common post-discharge postnatal complications reported by mothers regarding their infants, were coryza/cough (56%), fever ≥37.5°C (29%), skin infection (8.2%), diarrhoea (8%), absent defecation or urination (7%), jaundice diagnosed by a physician (7%), umbilical infection (6%), eye infection (5%), and respiratory distress (5%); rarer complications are found in Table 27. No differences were found between CS cases and NVD controls.

Table 27: Mother-reported neonatal complications, after hospital discharge

	NVD (%) (n=303)	CS (%) (n=344)	Total (%) (n=647)
"No complications"	18.5	20.9	19.8
Coryza/cough	58.1	54.4	56.1
Fever (≥ 37.5°C)	28.4	28.8	28.6
Skin infection	8.6	7.8	8.2
Diarrhoea	5.9	9.9	8.0
Absent defecation or urination	5.9	8.7	7.4
Jaundice	8.6	4.9	6.6
Umbilical infection	7.6	4.1	5.7
Eye infection	4.6	6.4	5.6
Respiratory distress	4.3	5.8	5.1
Pneumonia	5.3	2.9	4.0
Inability to feed	4.0	4.1	4.0
Vomiting	2.3	3.5	2.9
Oral thrush	2.6	0.9	1.7
Convulsions or unconsciousness	1.0	0.6	0.8
Decreased activity or lethargy	0.3	0.6	0.5
Inability to feed	0.7	0.3	0.5
Low temperature (≤ 35.5°C)	0.0	0.3	0.2
LBW (otherwise unspecified)	0.3	0.0	0.2
Other(s)	6.9	9.3	8.2

Neonatal deaths

There were n=9 (1%) neonatal deaths in our study population before hospital discharge. Reported causes or symptoms for neonatal death were as follows according to mother's report: birth asphyxia (n=4), low birth weight or failure to thrive (n=3), lethargy (n=1) and single fetal demise (n=1). The neonatal deaths occurring after hospital discharge (n=7) were due to the following reasons as reported by mother: LBW/failure to thrive, pneumonia, sepsis, respiratory distress, congenital heart disease, convulsion, and jaundice. As previously reported, there were n=12 stillbirths.

Care-seeking and decision-making behavior

Antepartum

More than 99% of women reported receiving antepartum (AP) care, with 96% attending 4 or more AP visits. At any of these visits, nearly all women saw a BRAC health worker (97%) and the majority saw an MBBS or further trained

doctor (63%). Women rarely saw a nurse or midwife (5%), trained traditional birth attendant (2%) or untrained traditional birth attendant (<1%) for AP care (Table 28).

Table 28: Types of antenatal care providers at any antepartum visit, N=731

	NVD (%) (n=341)	CS (%) (n=390)	Total (%)
BRAC health worker	96.2	98.5	97.4
Doctor (MBBS)	63.5	63.1	63.3
SACMO/Medical assistant	13.5	16.2	14.9
NGO paramedics	16.4	11.5	13.8
Other NGO health worker (besides BRAC)	12.0	10.8	11.3
Nurse/midwife	6.5	4.4	5.3
Trained TBA	2.1	1.3	1.6
Village doctor / pharmacist	1.8	1.3	1.5
Untrained TBA	0.6	0.8	0.7
Relatives	0.0	0.0	0.0
"Don't know"	0.9	0.5	0.7

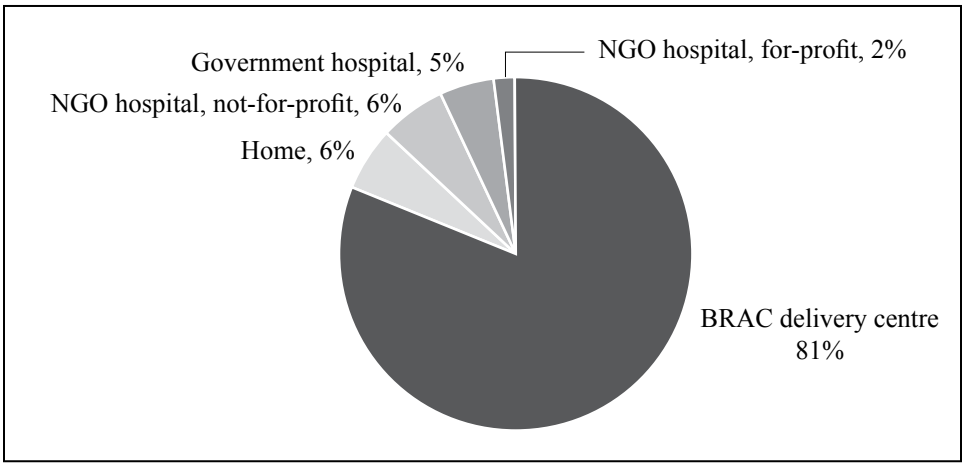
Responses are not mutually exclusive.

Intrapartum

Initially desired settings of delivery

Women in our study were most likely to have initially wanted to deliver at a BRAC delivery centre (81%); smaller proportions initially wanted to deliver at home (6%) or in a government (6%), not-for-profit NGO (6%), or for-profit NGO hospital (2%) (Figure 2). CS cases were more likely than NVD controls to have initially wanted to deliver at a hospital rather than home or BRAC delivery centre (OR 3.36, 95% CI [2.04-5.55]).

Figure 2: Initially desired place of delivery (n=732)



Mode of referral and referring Manoshi personnel

Table 29 shows the location from which women were referred by *Manoshi* program workers, whether they were referred by direct observation or over telephone, and who mainly made the referral. CS cases were more likely than NVD controls to be referred directly from home than from BRAC delivery centre (OR 1.93, 95% CI [1.36 – 2.74]).

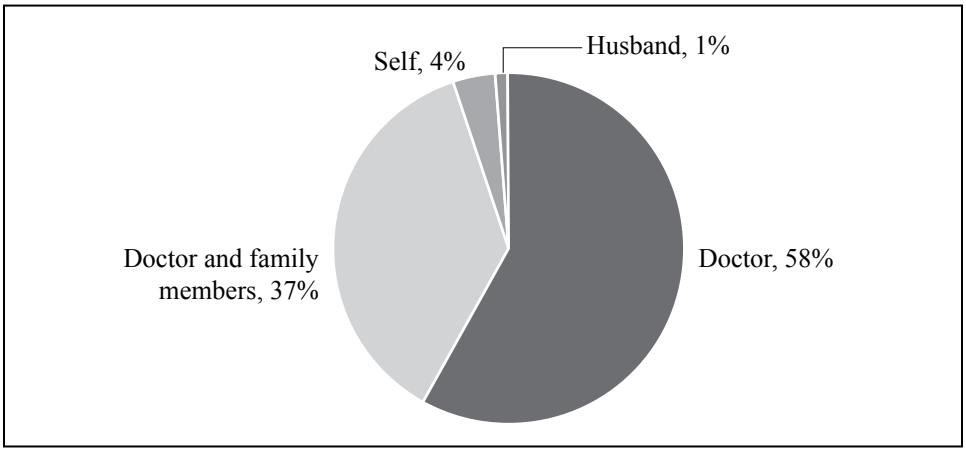
Table 29: Referral location, referral mode, and referring *Manoshi* personnel

		NVD (%) (n=342)	CS (%) (n=390)	Total (%)
Location of referral	Home	17.8	29.5	24.0
	BRAC delivery centre	82.2	70.5	76.0
Mode of referral	Direct observation	93.6	93.8	93.7
	Over telephone	6.4	6.2	6.3
Type of *Manoshi* worker who mainly made referral	UBA	3.2	0.5	1.8
	SS	2.3	0.5	1.4
	SK	61.1	65.9	63.7
	PO	16.4	18.2	17.3
	MMW	17.0	14.9	15.8

Decision for CS

When CS cases were asked "due to whose intention, mainly, was your CS delivery performed?", 58% identified the doctor, 37% identified the doctor and family members, and 4% identified themselves. Husbands and solely other family members made the decision in a minority of cases (1%) (Figure 3).

Figure 3: Primary decision maker for CS (n=390) ["To whose intention, mainly, was your cesarean delivery performed?"]



Survey question included "other family members", which accounted for < 1% of responses.

Trial of labour at home and other locations

Among all the study participants (N=732), 68% (n=495) of women experienced non-medicine-induced labour pain. Among women who did not experience normal labour pain or had medicine-induced labour pain, 49% were CS cases. Almost all NVD controls (97%) and the majority of CS cases (57%) reported experiencing labour pain before delivery (n=555). Of these, 89% of NVD controls (n=295) and 90% of CS cases (n=200) reported that their labour pain onset was "normal," while the rest were "medicine-induced" (n=60).

Regarding this subpopulation of women who experienced non-medicine-induced labour pain before delivery (NVD cases n=295, CS cases n=200), Table 30 shows the locations/facilities visited and trial of labour (TOL) at those locations. Among these, CS cases were more likely than NVD controls to have attempted TOL at home (OR 1.88, 95% CI [1.01-3.50]).

Table 30: Locations of care and trial of labour for women who experienced non-medicine-induced labour pain before delivery

	NVD (%) (n=295)	CS (%) (n=200)	Total (%) (N=495)
Visited BRAC Delivery Centre for normal delivery	83.1	79.5	81.6
Visited other facility before reaching terminal facility	9.2	12.0	10.3
TOL at home	6.8	12.0	8.9
TOL at other facility*	4.4	5.5	4.8
TOL at terminal facility	100.0	59.0	83.4

*n=268 (NVD), n= 176 (CS) did not visit other facility

Course and timing of care and three delays

Course of care and settings of trial of labour (TOL)

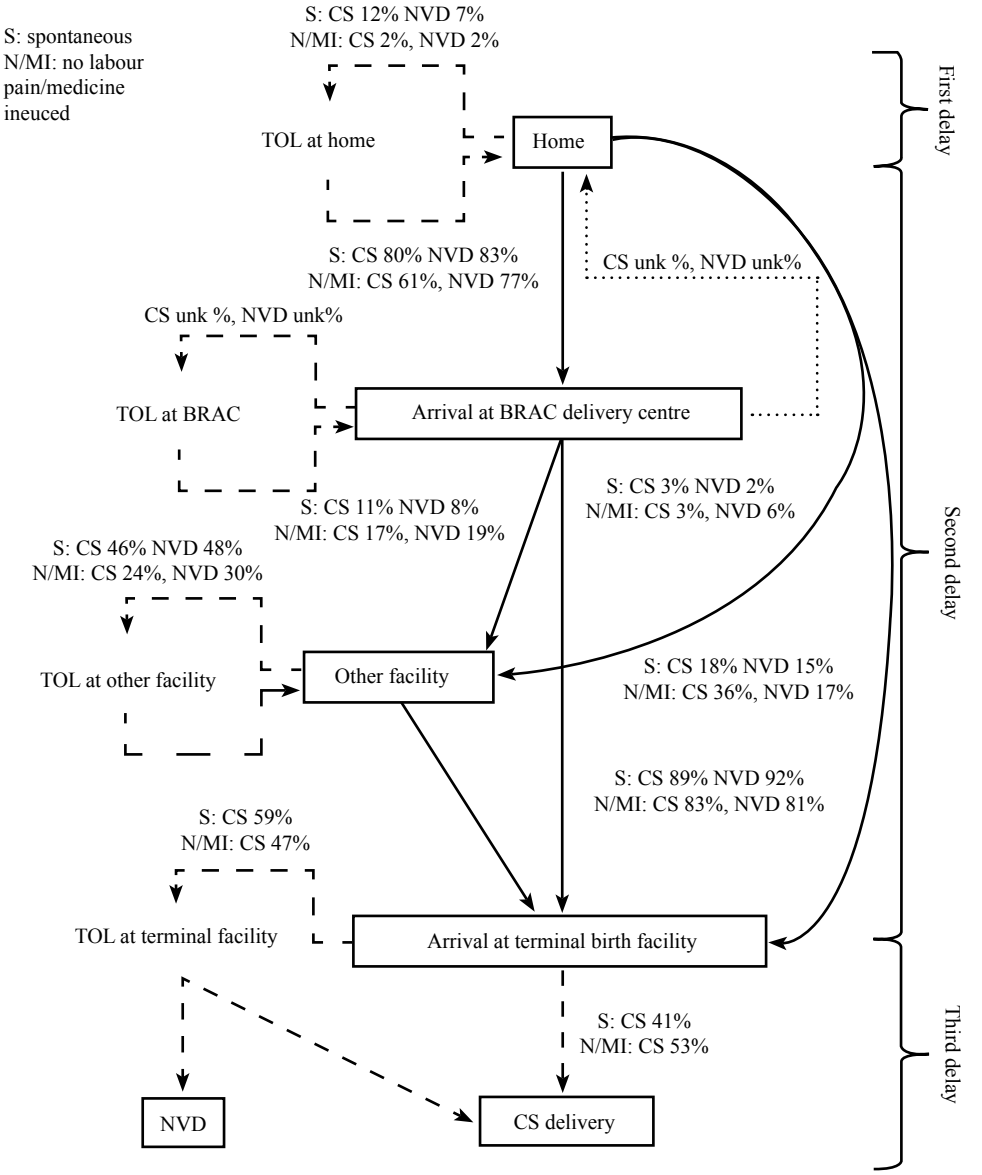
Figure 4 displays the different proportions of women seeking care and undergoing TOL at different settings in our study. Women were not asked specifically about TOL at BRAC delivery centre or whether they returned home after visiting BRAC delivery centre; however, feedback from field staff indicated that the latter was a common practice.

First, second, and third delays

Women were asked about the course of their care, time of transport between several points, and the date/time at which they experienced different birth events: onset of labour pain (if applicable), arrival at BRAC birthing hut (if applicable), arrival at terminal birth facility, and NVD or CS delivery. For this report, timings were only calculated among the subpopulation of women (n=495) who experienced non-medicine-induced labour pain before delivery (as a proxy, albeit a crude one, for spontaneous labour). Further information regarding timings for women who experienced medicine-induced labour pain or did not experience labour pain is available upon request, but were believed to contain in inherent bias in the intended interpretation of timings of labour.

The 'three delay model' is a well-accepted model to identify the main factors that delay a woman's access to effective interventions to prevent a maternal mortality. These delays occur in three phases; 1) delay in decision to seek care; 2) delay in reaching care; and 3) delay in receiving care once at the facility.

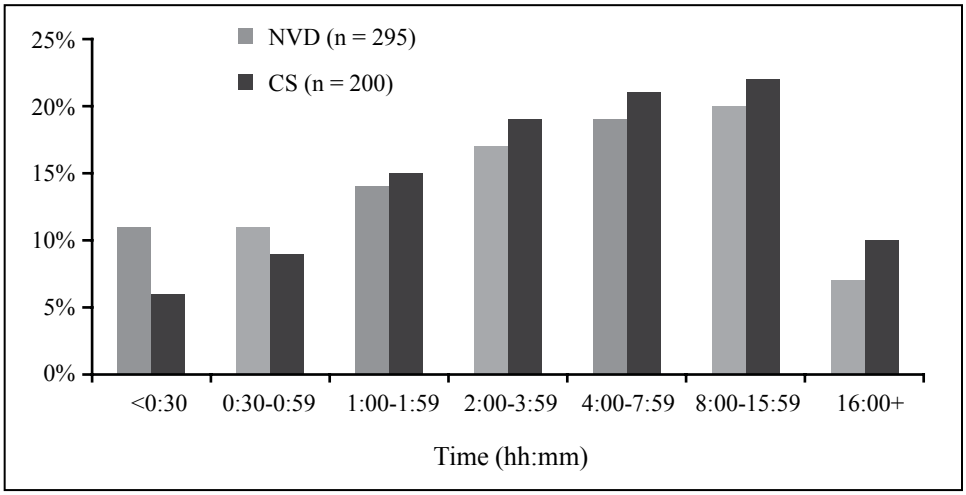
Figure 4: Course of care and trials of labour



Solid lines represent transport/travel times; dotted lines represent time passing within setting. All percentages calculated from the population at the tail of each arrow. "TOL" = trial of labour, "unk" = unknown or did not directly ask.

Regarding the first delay, Figure 5 shows the self-reported amount of time that the women who underwent non-medicine-induced labour pain before delivery spent at home after labour pain started. The proportions of women who went to BRAC delivery centre and did not go to BRAC delivery centre for normal delivery and who spent less than one hour at home were 24% NVD / 16% CS and16% NVD / 7% CS, respectively. Those spending 16 hours or more at home were 6% NVD / 6% CS and 12% NVD / 22% CS, respectively.

Figure 5: Self-reported duration of time spent at home, for women who experienced non-medicine-induced labour pain before delivery



Regarding the second delay, Table 31 shows the self-reported elapsed time after leaving home or BRAC delivery centre before reaching the facility. Interestingly, a large proportion of women who did not visit a facility other than a BRAC delivery centre reported elapsed time of 4 or more hours (45% CS cases and 59% NVD controls), perhaps due to some event other than transport directly to a facility.

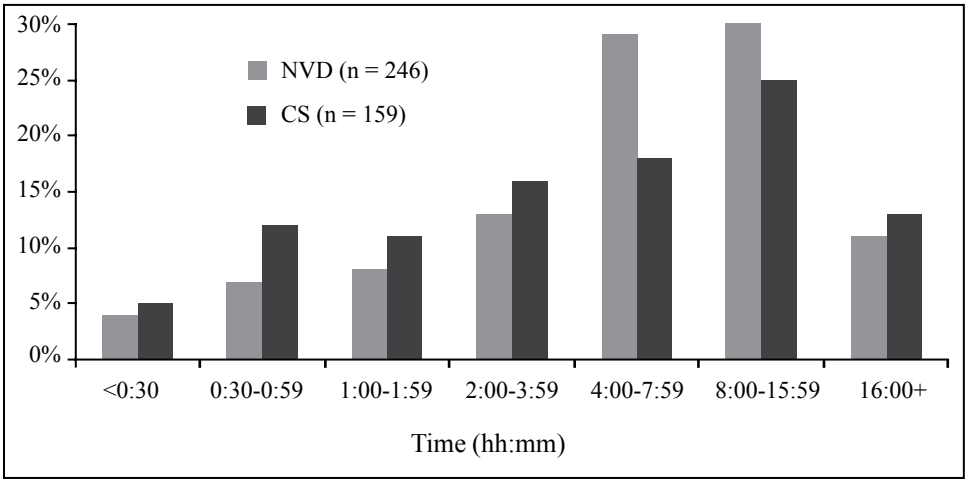
Figure 6 shows the self-reported durations regarding the amount of time spent at BRAC delivery centre. Within this subpopulation, only 5% of CS cases and 4% of NVD controls spent less than 30 minutes at BRAC delivery centre, 28% of CS cases and 19% of NVD controls spent less than 2 hours at BRAC delivery centre, and 13% of CS cases and 11% of NVD controls spent 16 hours or more at BRAC delivery centre.

Table 31: Self-reported elapsed time to reach terminal birth facility from BRAC delivery centre or home

	Time (hh:mm)	NVD (%)	CS (%)	Total (%)
Visited facility other than BRAC delivery centre (n=38)	< 0:15	0.0	0.0	0.0
	0:15 - 0:29	7.4	0.0	3.9
	0:30 - 0:44	22.2	29.2	25.5
	0:45 - 0:59	0.0	4.2	2.0
	1:00 - 1:59	59.3	62.5	60.8
	2:00 - 3:59	7.4	0.0	3.9
	4:00 - 7:59	0.0	0.0	0.0
	8:00+	3.7	4.2	3.9
Did not visit facility other than BRAC delivery centre (n=367)	< 0:15	0.0	0.6	0.2
	0:15 - 0:29	6.7	9.1	7.7
	0:30 - 0:44	29.5	26.1	28.2
	0:45 - 0:59	2.6	5.1	3.6
	1:00 - 1:59	45.1	51.1	47.5
	2:00 - 3:59	11.6	7.4	9.9
	4:00 - 7:59	1.1	0.0	0.7
	8:00+	3.4	0.6	2.3
Total	< 0:15	0.0	0.5	0.2
	0:15 - 0:29	6.8	8.0	7.3
	0:30 - 0:44	28.8	26.5	27.9
	0:45 - 0:59	2.4	5.0	3.4
	1:00 - 1:59	46.4	52.5	48.9
	2:00 - 3:59	11.2	6.5	9.3
	4:00 - 7:59	1.0	0.0	0.6
	8:00+	3.4	1.0	2.4

Only includes women with non-medicine-induced labour pain (n=495).

Figure 6: Self-reported duration of time spent at BRAC delivery centre, for women who experienced non-medicine-induced labour pain before delivery and who went to BRAC delivery centre



In terms of the third delay, the duration from date/time of arrival at terminal birth facility to date/time of delivery was calculated for women experiencing non-medicine-induced labour pain before delivery. (Table 31). Among these women, and who also did not undergo TOL at the terminal facility, 10% of the CS cases delivered in less than an hour, 25% less than 2 hours, and 49% less than 4 hours.

Table 32: Elapsed time from self-reported hospital arrival time to date/time of delivery

Timing	NVD (%) (n=295)	CS (%) (n=200)			Total (%) (n=495)
		TOL at facility (n=118)	No TOL at facility (n=82)	Total CS (n=200)	
0 - 59 min	12.2	0.8	9.8	4.5	9.1
1h - 1h 59 min	19.3	4.2	14.6	8.5	14.9
2h - 3h 59 min	21.0	19.5	24.4	21.5	21.2
4h - 7h 59 min	24.4	35.6	35.4	35.5	28.9
8h - 11h 59 min	7.1	13.6	7.3	11.0	8.7
12h - 23h 59 min	10.8	16.9	2.4	11.0	10.9
24+ h	5.1	9.3	6.1	8.0	6.3

Only includes women who experienced non-medicine-induced labour pain prior to delivery.

Economic consequences

Costing

Costs of delivery care related to referral incidence are presented considering three stages of delivery care, specifically before referral, during delivery care and after discharge. The costs are also separated into public, private and NGO facilities. Finally, the sources of funding are presented.

Before referral

The costs incurred before coming to the referral facility are presented in Table 33. This cost is highest among the mothers who were referred to private facility (975 BDT) followed by the NGO facility (358.5 BDT) and public facility (176.7 BDT). Average cost before CS deliveries in private, NGO and public facilities are 646.3 BDT, 389.5 BDT and 197.5 BDT respectively. NVD controls who were referred to a private facility spent, on average, 1413.3 BDT. Corresponding spending is 320 BDT and 135.2 BDT for all women who were referred to NGO and public facility, respectively.

Table 33: Average cost (BDT) incurred before referral to the terminal birth facility

	Public provider			NGO provider			Private provider		
	NVD	CS	Total	NVD	CS	Total	NVD	CS	Total
Travel cost	135.2	105.0	115.1	145.4	100.8	120.7	86.7	45.0	62.9
Treatment cost	0.0	59.0	39.3	119.6	240.3	186.4	493.3	377.5	427.1
Other cost	0.0	33.5	22.3	55.0	48.4	51.3	833.3	223.8	485.0
Total cost	135.2	197.5	176.7	320.0	389.5	358.5	1,413.3	646.3	975.0
No of observations	5	10	15	25	31	56	6	8	14

During stay in referral facilities

Among the facilities, the highest in-facility costs (15,980 BDT) were incurred when women saw private providers, followed by NGO (9,410 BDT) and public providers (7,775 BDT). Average cost for NVD and CS in the referral facilities are presented in Table 34. The costs are separated into public, private and NGO facilities. The highest average cost for NVD and CS are incurred in private facilities. Costs in

Table 34: Average cost (BDT) for NVD and CS in the terminal birth facility

	Public provider			NGO provider			Private provider		
	NVD	CS	Total	NVD	CS	Total	NVD	CS	Total
Travel cost	203.4	195.5	199.5	134.3	123.3	127.9	153.3	205.7	199.6
Treatment cost	2,417.5	5,923.3	4,148.8	2,346.2	10,569.4	7,099.1	3,120.0	12,684.8	11,581.2
Food cost	190.3	563.2	374.4	180.1	501.7	366.0	566.7	814.8	786.2
Other cost	731.3	1,640.5	1,180.3	205.7	249.2	230.8	586.7	334.8	363.8
Newborn cost	320.2	498.3	408.2	271.8	718.3	529.8	6,666.7	887.0	1,553.8
Mothers' income loss	258.6	933.9	592.1	203.7	645.9	459.3	530.0	402.8	417.5
Attendants' income loss	509.6	1,217.7	859.3	281.8	811.0	587.7	3,173.5	793.3	1,068.0
Staff cost	13.5	13.0	13.3	10.3	9.1	9.6	1.8	11.6	10.5
Total cost	4,644.3	10,985.4	7,775.9	3,634.0	13,627.9	9,410.3	14,798.6	16,134.7	15,980.5
No of observation	247	241	488	92	126	218	3	23	26

private facility for NVD are 3.2 times higher than the public facility. However, CS delivery cost is only 1.5 times higher in private facility in comparison to public facility.

Treatment cost (like, admission fee, diagnosis charge, physician visit fee, medication cost etc.) is the main driver of total cost for NVD and CS delivery in the referral facilities. However, treatment cost is the highest in every facility among other cost components.

Average cost (BDT) after delivery

Average costs incurred for complications of mother and newborn after discharge from the referral facility are presented in Table 35. Average costs for an episode of maternal complication after delivery from private, NGO and public facilities were 712.7 BDT, 1063.3 BDT and 824.1 BDT, respectively. In all facilities, complication after CS delivery required higher spending than NVD. Newborn sickness after discharge from referred facilities required, on average, 912.5 BDT spending in private facilities, 1518.1 BDT in NGO facilities and 968.5 BDT in public facilities

Treatment costs for complication after discharge for the mother and newborn is highest, followed by travel cost, food cost and other costs. For mothers, the cost of complication for CS cases was higher than NVD controls. But, in case of newborns, this cost is higher for NVD controls. Between different providers, NGO has highest cost for treatment of complications, followed by public and private provider, for both maternal and newborn complications.

Source of funding of delivery care

Households depend on multiple funding sources to meet the costs for delivery care. Household income (mother's income, husband's income or other member's income), borrowing (taking formal loan or borrowing from relatives or friends and neighbor) and *Manoshi* aid were the most frequently used funding sources. We observed that 78.1% of mothers who were referred by *Manoshi* partially managed their treatment costs from household income, 68.9% depend on borrowed money, and 62.6% received aid from *Manoshi*. Remaining funding sources are used less frequently by the households, and listed in Table 36.

Table 35: Average cost (BDT) for maternal and neonatal complications after discharge from terminal birth facility, by facility type and mode of delivery

		Public provider			NGO provider			Private provider		
		NVD	CS	Total	NVD	CS	Total	NVD	CS	Total
Cost for complication after delivery of mother	Travel	44.4	170.6	106.7	65.0	214.8	151.6	0.0	147.0	130.0
	Treatment	383.3	978.4	677.2	414.9	1,024.4	767.2	100.0	667.4	601.9
	Food	1.4	52.9	26.9	2.2	153.2	89.4	0.0	21.7	19.2
	Other	20.7	2.3	11.6	0.5	1.0	0.8	0.0	0.0	0.0
	Total	450.2	1,207.3	824.1	590.3	1,408.7	1,063.3	100.0	792.6	712.7
Cost of treatment for sickness of newborn	Travel	95.3	68.8	82.2	232.8	97.5	154.6	100.0	90.4	91.5
	Treatment	763.1	572.9	669.2	2,462.8	502.3	1,329.6	1,100.0	775.0	812.5
	Food	14.4	23.8	19.0	43.5	31.0	36.2	0.0	9.6	8.5
	Other	1.7	16.3	8.9	0.0	2.9	1.7	0.0	0.0	0.0
	Total	1,159.6	772.5	968.5	2,736.1	628.7	1,518.1	1,200.0	875.0	912.5
No of observation		247	241	488	92	126	218	3	23	26

Table 36: Sources of funding delivery care

Sources*	Frequency	Percent (%)
Household income	572	78.1
Household Savings	44	6.0
Borrowing	504	68.9
Selling	4	0.6
Donation	7	1.0
Manoshi	458	62.6
Others	18	2.5
Total	732	

*Multiple responses are considered.

Funding source specific average amount

Table 37 shows funding source specific average amount (BDT) and share by types of delivery. Households, on average, spent 1,974.9 BDT from household income (39% share), 2,136.2 BDT from borrowing (42% share) and 695 BDT from *Manoshi* aid (14% share). NVD controls utilized household income (1,343.5 BDT) as the leading source of spending, followed by borrowing (1,054.5 BDT) and *Manoshi* aid (417.2 BDT). In contrast, CS cases used borrowing (3,058.5 BDT) as the leading source of spending, followed by household income (2,528.5 BDT) and *Manoshi* aid (938.6 BDT). For both CS cases and NVD controls, *Manoshi* shares on spending were similar (14.0% NVD, 13.7% CS).

Table 37: Funding source specific average amount (BDT) and share, by mode of delivery

	NVD		CS		Total	
	Amount	Share (%)	Amount	Share (%)	Amount	Share (%)
Household income	1,343.5	45.0	2,528.5	37.0	1,974.9	39.2
Household Savings	80.5	2.7	204.5	3.0	146.6	2.9
Borrowing	1,084.5	36.4	3,058.5	44.7	2,136.2	42.4
Selling	9.5	0.3	2.6	0.0	5.8	0.1
Donation	25.6	0.9	47.4	0.7	37.2	0.7
Manoshi	417.2	14.0	938.6	13.7	695.0	13.8
Others	22.0	0.7	61.0	0.9	42.8	0.8
Total	2,982.8	100	6,841.0	100	5,038.4	100
No of observation	342		390		732	

Percentage of total cost shared by Manoshi

Percentages of total costs shared by *Manoshi* are presented in Table 38. Here the sum of reimbursement reported by mothers and staff cost (opportunity cost for staff time) are considered as the total spending by *Manoshi* for these referred cases. We observed that *Manoshi* shared highest cost in public facilities (11%) followed by NGO (6.5%) and private facilities (1.3%).

Overall financial coping mechanisms

We asked study women at follow-up interview to identify the coping mechanisms that they used for expenditures made during delivery and after discharge from the hospital. The majority of households (91% in NVD controls and 90% in CS cases) coped with their regular family income or savings. Other sources included aid from *Manoshi* (75% in NVD controls and 79% in CS cases); borrowing or taking loan from relatives, neighbors, friends, NGO lenders and other loan sources (67% in NVD controls and 78% in CS cases); receiving donations from different sources (55% in NVD controls and 60% in CS cases); and selling or mortgaging household assets (6% in NVD controls and 13% in CS cases).

Apart from receiving economic help, households had to compromise food quality and amount of consumption, delayed seeking healthcare, decreased recreational costs and even changed houses or moved to low cost rented houses. Among the mentioned mechanisms, CS cases were more likely to sell or mortgage household assets ($p=0.005$), borrow money ($p=0.001$), postpone previous loan payment ($p=0.032$), decrease recreational costs ($p=0.026$), purchase fewer necessary household materials ($p=0.018$), and delay or never seek healthcare ($p=0.019$). Detailed information is given in Table 39.

Table 38: Percentage of total cost (BDT) shared by Manoshi, by facility type and mode of delivery

		Public provider			NGO provider			Private provider		
		NVD	CS	Total	NVD	CS	Total	NVD	CS	Total
Manoshi	Staff cost	13	13	13	10	9	10	2	12	10
	Reimbursement	518	1,041	776	161	874	573	0	217	192
	Total	531	1,054	789	171	883	583	2	229	203
Total treatment cost		4,386	10,052	7,184	3,430	12,982	8,951	14,269	15,732	15,563
Percentage shared by *Manoshi*		12.1	10.5	11.0	5.0	6.8	6.5	0.0	1.5	1.3

Table 39: Coping mechanisms for overall household delivery-related expenditures

Coping mechanism	NVD (%) (n=317)	CS (%) (n=352)	Total (%) (N=669)	P value
From regular family income or savings	90.9	89.8	90.3	0.638
From BRAC *Manoshi* help	74.8	79.6	77.3	0.141
Selling or mortgaging household asset*	6.3	12.8	9.7	0.005
Borrowed money or took loan from others*	67.2	78.7	73.2	0.001
Donations from others	54.9	60.2	57.7	0.163
Postponed or did not pay previous loan*	37.5	45.7	41.9	0.032
Decreased self or family recreational expenditure*	16.4	23.3	20.0	0.026
Decreased quality or consumption of regular food	64.4	70.2	67.4	0.109
Decreased expenditure on buying necessary HH assets, clothes, shoes, etc*	37.9	46.9	42.6	0.018
Increased working hours	15.5	17.1	16.3	0.579
Delayed or never sought healthcare/defer payment for healthcare expenditure*	23.7	31.8	28.0	0.019
Delayed in paying house rent or moved to low cost rented house	7.9	12.2	10.2	0.064
Others	15.5	18.2	16.9	0.348

*These results are considered significant at ($p \leq 0.05$).
Responses are not mutually exclusive.

Household food insecurity/access

Household food insecurity at follow-up interview was measured using both the Household Food Insecurity Access Scale (HFIAS) and the Household Hunger Scale (HHS), which use a common 9 item 4 frequency survey but calculate the scoring differently. Results are given in Table 37 and Figure 7. Notably, 2% of families reported having "severe household hunger" (HHS) and 14% reported being "severely food insecure" (HFIAS). Regarding the HHS, there was no difference in relative odds between CS cases and NVD controls for moderate and severe household hunger, although the lower end of "moderate household hunger" was near the 95% CI cutoff of 1 Table 37. There was no difference found between CS cases and NVD controls on the HFIAS scale.

Figure 7: Household Hunger Scale scores at follow-up interview

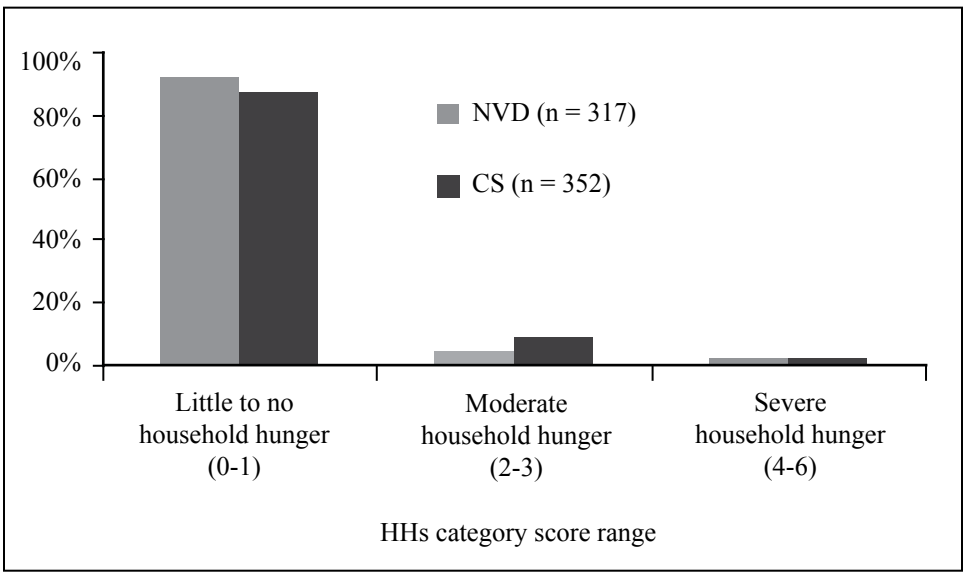


Table 40: Household Hunger Scale scores and Household Food Insecurity Access Scale categories

		NVD (%) (n=317)	CS (%) (n=352)	Total (%) (N=669)
HHS (3 item, 3 frequency scale)	Little to no household hunger (0 - 1)	92.4	88.4	90.3
	Moderate household hunger (2 - 3)	5.4	9.4	7.5
	Severe household hunger (4 - 6)	2.2	2.3	2.2
HFIAS (9 item, 4 frequency scale)	Food secure	31.2	27.0	29.0
	Mildly food insecure	44.8	42.9	43.8
	Moderately food insecure	11.4	14.8	13.2
	Severely food insecure	12.6	15.3	14.1

HFIAS scored and categorized according to Coates et al, August 2007[18]. HHS scored and categorized according to Deitchler et al, May 2010[20].

Table 41. Relative odds for scoring as "moderate" or "severe" household hunger on the HHS

	Odds ratio (CS/ NVD)	95% Confidence interval	
Moderate household hunger (score 2 - 3)	1.829	0.997	3.354
Severe household hunger (score 4 - 6)	1.077	0.386	3.006

The reference category is: Little to no household hunger (score 0 - 1).

Social consequences

Opinions regarding status in family and relationships

Women were asked about their overall status in their family at post-discharge interview, using an ordinal scale of 1 (very low) to 5 (very high). The values and differences are shown in Table 42 where 12% of CS cases and 10% of NVD controls reported their family status as "low" or "very low". When we calculated the difference in the scaled scores between status before delivery and after delivery, only 7% of CS cases and 4% of NVD controls reported a lower score than the score they reported when recalling their status before delivery.

General attitudes toward the changes in more specific relationships with husband (if applicable), other family members (if applicable), and community members are also given in Table 43. Notably, 15% of CS cases and 11% of NVD controls reported a worsening in relationship with their husbands since before delivery, as opposed to improving or remaining the same as before delivery.

Table 42: Opinions regarding overall status in family and perceived change from before delivery, at follow-up interview

		NVD (%) (n=317)	CS (%) (n=352)	Total (%) (N=669)
Overall position in family after delivery	Very low (1)	2.5	1.7	2.1
	Low (2)	7.3	10.5	9.0
	Medium (3)	54.9	50.3	52.5
	High (4)	32.5	35.8	34.2
	Very high (5)	2.8	1.7	2.2
Change in overall position in family from before delivery to after delivery (negative score indicates decrease in perceived status)	-2	0.0	0.9	0.4
	-1	4.4	6.3	5.4
	No change	81.4	79.0	80.1
	+1	13.9	13.4	13.6
	+2	0.3	0.6	0.4

Table 43: Opinions regarding changes in general relationships with husband, family, and community members at follow-up interview

	Change in relationship	Mode of delivery		Total (%)
		NVD (%)	CS (%)	
Family members other than husband* (NVD n=151, CS n=180)	Better or remained the same	94.0	94.4	94.3
	Worsened	6.0	5.6	5.7
Non-family community members (NVD n=317, CS n=351)	Better or remained the same	95.6	92.9	94.2
	Worsened	4.4	6.8	5.7
Husband** (NVD n=312, CS n=349)	Better or remained the same	89.4	85.1	87.1
	Worsened	10.6	14.9	12.9

*Only includes women who lived with family members other than their husband (n=331).
**Only includes women who completed follow-up, who were currently married or separated at time of in-hospital interview (n=661).

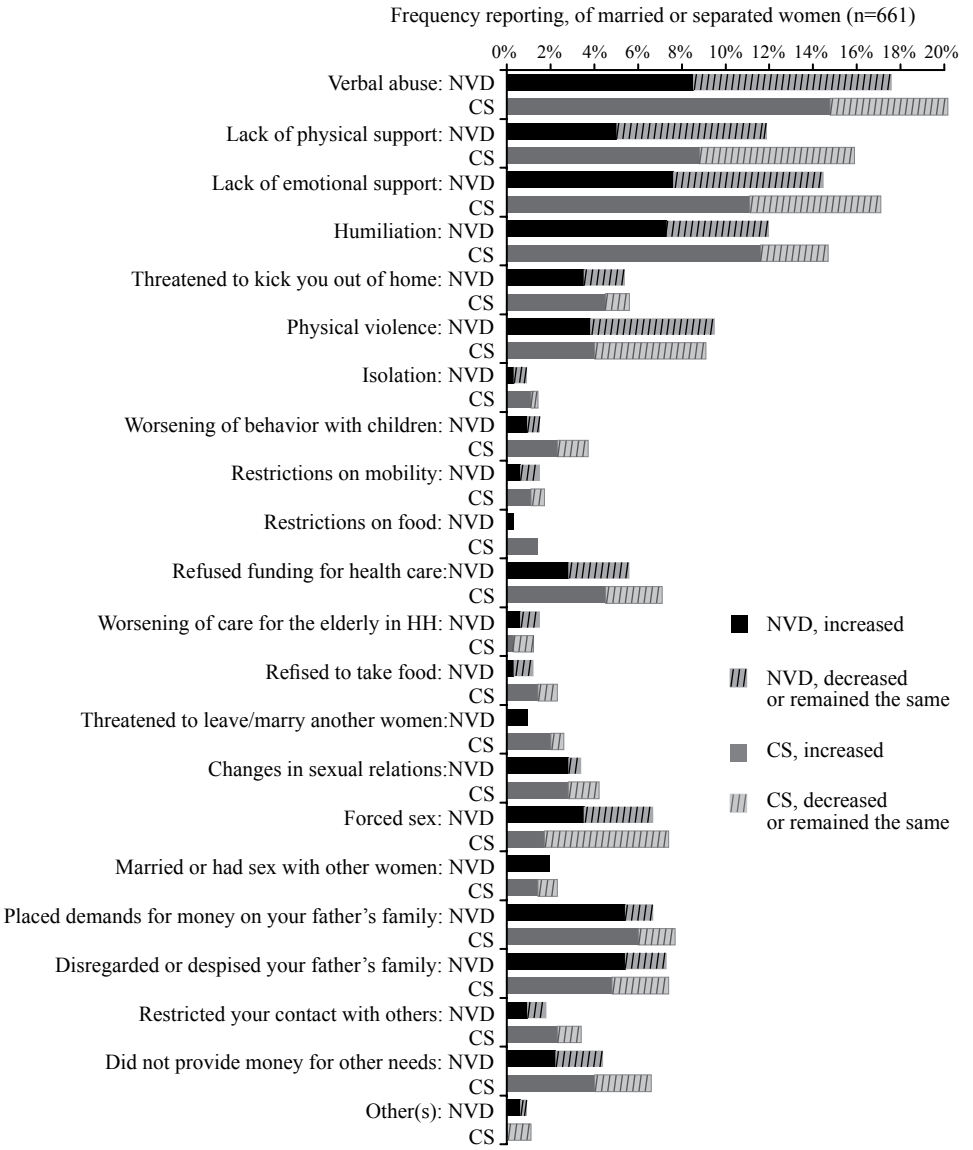
Specific behaviours of abuse and/or neglect by husbands

Currently married or separated women were asked about specific behaviours of abuse and neglect from their husbands (Figure 8). The most common behaviours in the study population were verbal abuse (21%); lack of emotional support (14%)

which included decreased or no conversation or empathy; lack of physical support (14%) which included contributing less or none to daily household chores and work; and physical violence (9%) which included beating, slapping, kicking, pulling hair and/or placing hot materials on woman's body. A total of 31% of CS cases and 27% of NVD controls reported at least one of the listed behaviours of abuse/neglect by their husband.

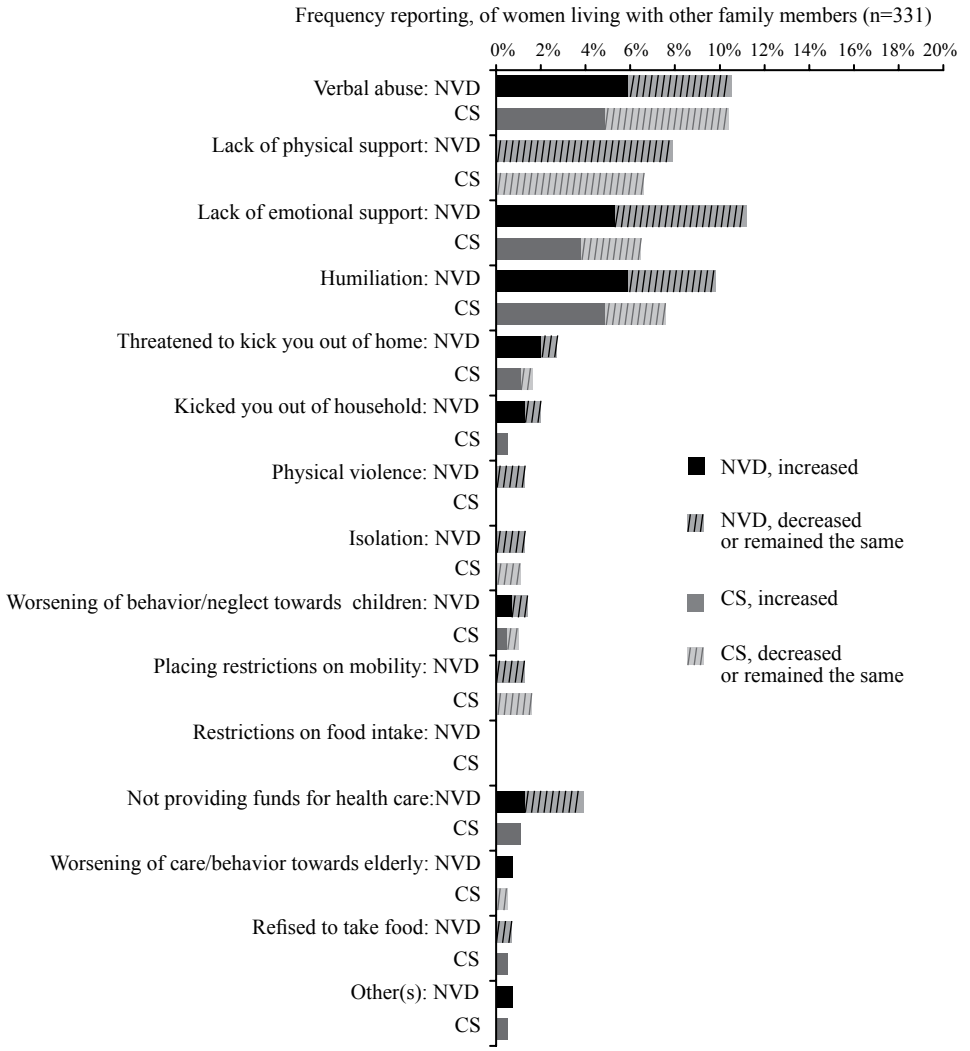
All women were asked about specific behaviours of abuse and neglect by family members other than their husband (if applicable) as shown in Figure 9. The most common behaviours were lack of physical support (50%), verbal abuse (8%), lack of emotional support (6%) and humiliation (6%). A total of 14% of both CS cases and NVD controls reported at least one of the listed behaviours of abuse or neglect by family members other than their husband.

Figure 8: Specific behaviours of abuse and neglect performed by husbands after delivery, reported by women



Solid bars represent increases in frequency, diagonal bars represent "no change" or decrease in frequency.

Figure 9: Specific behaviours of abuse and neglect by family members other than husbands after delivery, reported by women



Solid bars represent increases in frequency, diagonal bars represent "no change" or decrease in frequency.

*Data unavailable for increase/decrease for "lack of physical support". Entire bar represents yes/no responses only.

DISCUSSION

This study examined the course of care, care-seeking behaviors, and medical, social, and economic consequences for women from the urban slums of Dhaka who were referred to facilities for childbirth from BRAC's *Manoshi* program areas. It was a mixed retrospective/prospective, case-control study using women who underwent cesarean section (CS) delivery as cases, and those who underwent normal vaginal delivery (NVD) as controls. The selection of cases and controls was done at the referral facility where delivery took place.

Except for a few key pieces of information, all data was obtained by interviewing mothers directly, once in the facility and once at least six weeks after hospital discharge. Medical documentation can be inconsistent and difficult to access in Bangladesh, especially at facilities which are poorly resourced and frontline clinical workers are extremely busy. While there are also many limitations and potential inaccuracies involved in using surveys for recalling (especially maternal complications[25]), these data also represent a unique insight into the mothers' understanding of the course and consequences of childbirth, as well as the opportunity screen for specific and important outcomes such as postpartum depression, household food insecurity, medical consumer costs, and behaviours of abuse/neglect by husbands and family members.

The following represents preliminary discussion of the study results. More detailed analysis of specific aspects of the study will be undertaken and submitted for publication.

Medical care and complications

This report describes the self-reported rates of different antepartum, intrapartum, and postpartum maternal and neonatal complications. A full discussion of each is beyond the scope of this report. However, medical complications which were significant or of particularly high prevalence are discussed here.

CS cases were found to be more likely than NVD controls to have experienced two antepartum complications, severe headache and blurring of vision; both are common symptoms of preeclampsia. American College of Obstetrician and Gynecology (ACOG) practice guidelines suggest that, in the absence of other indications, mild and severe preeclampsia can be managed with magnesium

sulfate and antihypertensive medications[26]. They cite two retrospective studies, which found that severely preeclamptic women can deliver through vagina after induction of labour (IOL), rather than CS, with no increased harm even to LBW infants[27-28]. Though we did not collect comprehensive medical data on whether women in our study were candidates for induction of labour, it does raise concern whether this proportion of CS cases (10%) actually did require CS for preeclampsia or preeclampsia-like symptoms, or if they could have undergone IOL as an alternative.

Our results show some discrepancy between gestational age, as calculated from self-reported EDD and date/time of delivery, and "postdate" included in the indication(s) for referral and CS. Eighty-one percent and 83% of women were referred for postdate and 83% had postdate included in the CS indication. An initial concern is the accuracy of the EDD which women report, as LMP can be difficult to recall and ultrasound dating becomes increasingly inaccurate after 20 weeks gestational age (+/- 7 days at 20 weeks, to +/- 21 days beyond 30 weeks)[29]. Inaccurate initial dating is the major reason for postdate pregnancies[29]. The term "postdate" also has a variable definition among clinicians, as a 2004 survey of American obstetrician/gynecologists showed that 43% considered 41 weeks GA as "postdate", whereas 48% defined it as 42 weeks or greater[30]. Despite these issues, both ACOG and RCOG guidelines recommend induction of labour or expectant management once the woman has reached 42 weeks, though it can be considered beginning at 41 weeks. Neither allude to a need for CS, unless another indication arises or labour induction fails[29, 31]. However, women who are routinely induced at 41 weeks may have lower rate of cesarean section due to less fetal distress, without increased risk to the fetus[29, 32].

CS cases were more likely to experience coryza/cough in the immediate postpartum period, and wound infection or possible wound infection after hospital discharge. We report the latter figure with caution, noting the high self-reported rates of wound infection or possible wound infection (33% of CS cases). Most studies cite a rate of 5%[33-34]. While the rate may be expected to be higher in this population because of poor sanitation and living conditions, poor wound care, or lower quality of facilities, the increase more likely suggests a misinterpretation of the survey question, or misinformed beliefs by mothers about the actual signs and symptoms of a wound infection after cesarean section.

The rates of MnDD/MDD that we found (27%) at follow-up are similar but slightly higher than the rate of 22% found by Gausia et al in rural Bangladesh, when using cutoff score of 10[11]. Although the EPDS has shown varying sensitivity (34-100%) and specificity (44-100%) among different cultural and linguistic contexts[35], its translation into Bangla and validation for use in the Bangladeshi context showed sensitivity of 89% and specificity of 87%[11-12]. However, using the optimal scoring suggested by Chaudron et al.[19], which was validated in low socioeconomic women in the United States, the rates of postpartum depression may in fact be even higher. Despite this, the results do suggest that rural and urban rates of postpartum depression in Bangladesh near 6-8 weeks are similar; we did not demonstrate a difference between women who undergo NVD and CS, and our rate may be higher because we only interviewed women who delivered at facilities.

Significant results from the in-hospital administration of the EPDS (i.e. CS cases more likely to score positive for MDD by the Chaudron et al cutoff of 9) should be interpreted with caution, due to the clinical condition of "postpartum blues", a period of crying, irritability, fatigue, and emotional lability which lasts as long as 2 weeks postpartum, and which affects nearly 50-75% of women[36]. These transient symptoms may affect the accuracy of a screening questionnaire like the EPDS; however, small studies suggest that it might be effective to predict future postpartum depression if administered only 3 days after vaginal delivery[37].

Regardless, the incidence of postpartum depression in these women is an important contribution and, given the potentially harmful negative effects, an important area to target with policies and programs among this urban slum population.

Care seeking behavior and course of care

Women in our study had high rates of antepartum care compared to the general population in 2010, regarding at least one AP visit form any provider (99% v. 71%), at least one AP visit from medically-trained provider (63% v. 54%), and 4+ AP visits from any provider(s) (97% v. 23%)[6]. This is commendable, and a strong feature of the *Manoshi* program. While it does not represent the overall rate in the entire *Manoshi* program – only in referred cases – it indicates that nearly all women who eventually require referral have had at least one, and often 4 or more, opportunities for *Manoshi* to evaluate, intervene, empower, and educate these mothers before they deliver.

CS cases were also more likely than NVD controls to have initially wanted to deliver at a hospital, rather than home or at a birthing hut. This latter fact most likely reflects the interplay of maternal preferences for CS, which is a major contributor to the rising CS rate[2].

Regarding the course of care, a fair number of women reported timings consistent with some other event occurring between leaving BRAC delivery centre and arriving at facility (which we conservatively assumed to be anytime > 4 hours). Finally, that 51% of CS cases who self-reported that they did not undergo TOL at terminal delivery facility spent longer than 4 hours to deliver, is a cause for concern. These reasons may have been justified medically due to information taken between referral and eventual delivery, or the women's answers to the questions about timings or attempt for TOL may have been different than our interpretation.

We note that CS cases were more likely than NVD controls to have attempted TOL at home. The strong selection bias in our facility-based study precludes this conclusion that home trial of labour is a risk factor to undergo CS, as does our unadjusted analysis. The CS group could be artificially inflated because NVD's were completed at home and, thus, were not included in our study population. Also, women at high-risk of complications may also have been referred more appropriately, or informed to seek care earlier in the birthing process by antepartum providers, intrpartum providers, family members, etc.

Economic consequences

The total average cost before reaching the terminal birth facility was 975 BDT in private facility, 358 BDT in NGO facility and 176 BDT in public facility. This cost is highest in private facility. However, only a few mothers (3% in public, 26% in NGO and 54% in private facilities) have spent before reaching referred facility.

During stay in terminal birth facility, the cost for private facility (15,980 BDT) is almost 2 times greater than public facilities (7,776 BDT). These higher costs can be attributed to the higher treatment cost for both NVD and CS delivery. In public facilities, CS delivery cost was 2.4 times of NVD because of the higher treatment cost and higher income loss of mother and caregiver.

Caesarian-Section deliveries require longer stay in public and NGO facilities (3.6 times in public facility and 3.2 times in NGO facility), which drive up mother and

caregiver income loss. NGO provider shows highest difference between cost of normal delivery (3,634 BDT) and CS delivery (13,627 BDT). This is also because of higher treatment cost and length of stay for CS delivery.

The average cost for both maternal and newborn complications after discharge are highest in NGO facilities, followed by public and private facility. This study observed that mothers incurred a higher average for complications after CS delivery than NVD, whereas newborns incurred a lower average cost for complications after CS delivery than NVD.

To meet delivery costs, households mostly depend on their income (78.1% of households), borrowing (68.9% of households) and reimbursement from *Manoshi* (62.6% of households). However, household recovered 39.2% of cost from household income, 42.4% from borrowing and 13.8% from *Manoshi*. Islam et. al. undertook a cost analysis of *Manoshi* delivery centre from provider perspective. In that study, the average cost of normal delivery conducted at the *Manoshi* delivery centre was calculated to be 1,167 BDT[38]. We however, found that cost of normal delivery conducted at the public facility is 4,644 BDT, 3634 BDT at the NGO facility, and 14798 BDT at the private facility. We observed higher cost in these facilities than at Manoshi delivery centres, which could be for any number of reasons including, but not limited to, more complicated conditions requiring more intensive medical care, longer duration of care surrounding birth, greater opportunity cost, transport costs and infrastructural costs.

Overall, the costs shared by *Manoshi* are low and are similar across types of birth outcome (CS and NVD), but dissimilar across types of facilities (private, NGO and public). Direct payments for treatment costs, (to pharmacies in the case of public deliveries and to hospitals as a "package" payment in the case of NGO facilities) are the main cost driver, while staff cost accounts for a very small part of total *Manoshi* cost.

Household food insecurity scores indicate that food insecurity is an important issue in this population. CS cases were more likely than NVD controls to score as having "moderate household hunger" on the HHS. We use the simpler 3-item, 3-frequency HHS system for scoring and categorization, because Deitchler et al. developed it when validation studies of the 9-item, 4-frequency HFIAS could not be validated[20]. Though we cannot conclude causation as we did not have a baseline measure and the tool is still being validated, household hunger is undoubtedly an

important issue for women postpartum, and possibly even greater for those who undergo CS and its associated costs.

Social consequences

The rates of intimate partner violence in our study (31% CS cases and 27% NVD controls) were similar to other reports in Bangladesh. The 2000-2003 WHO multi-country study on women's health and domestic violence found that 30% of Bangladeshi women in Dhaka reported experiencing physical or sexual intimate partner violence in the last year[39]. Using Bangladesh Demographic Health Survey 2004 data, Silverman et al found that 42% of husbands of mothers with children less than 5 years of age reported committing intimate partner violence in the past year[40]. The higher rate seen when men report committing intimate partner violence may reflect underreporting by women, as was the mode of reporting in the WHO study and this study.

More concerning is the number of women in our study who identified specific behaviours of IPV as "increasing" since before delivery; for most specific instances, this was more than 50% of women who experienced each form of IPV. Though the difference for specific acts of IPV between CS cases and NVD controls was not found to be statistically significant, CS cases were marginally more likely than NVD controls in experiencing almost all of the reported forms of IPV.

The consequences of intimate partner violence on mothers carries many potential negative health effects also for the child. Exposure to domestic violence has been linked with higher odds of respiratory infections, asthma, diarrhea, illness requiring a doctor, and overall health[41]. Silverman et al found that mothers who experienced intimate partner violence were significantly more likely to report both recent acute respiratory infections and diarrhea in their children within prior two weeks[40]. In Kenya, a mother's experience of IPV showed increased odds for moderate growth stunting (a surrogate for childhood under-nutrition), a marginal increase was also seen in Honduras and Malawi[42]. This is an important concern, not only for the mother's sake, but also for the child's physical and mental health and development.

From our study, we can see that IPV and domestic abuse are important in significant proportion of urban slum mothers, often increased after a woman delivers, have potentially negative medical (not to mention psychological) consequences, and represent area with significant that requires urgent attention from policymakers and programs.

Supply and demand factors

One specific objective of this study was to document the supply and demand factors associated with CS delivery. The decision for CS is a very complex one, involving not only medical characteristics of the pregnant mother and her fetus, but maternal attitudes and desires toward CS, familial attitudes toward CS, attempts to trial at home, the mother's education about LMP/EDD and the onset of labour, financial ability to pay, and more. While rigorous analysis is beyond the scope of this report (and perhaps of this study), we present unique data, which touch on several important but understudied supply and demand factors towards the decision to perform CS in Bangladesh.

Notably, 95% of women identified the doctor or the doctor and his/her family members as the main decision-makers when deciding to perform CS. Certain medical conditions, notably previous CS (20% of CS cases) and postdate (18% of CS cases), were commonly part of the documented indication, but which do not necessarily require CS. Financial incentive for the providers to perform CS is beyond the scope of this study, as the provider reimbursement cannot be assumed to directly correlate with, but the higher costs incurred by CS cases are a cause for concern for this issue. Given the potential negative effects of CS on mothers, neonates, and families that we attempt to explore in this study – and which extend beyond only increased medical risk – the need to ensure the necessity of CS is becoming increasingly important for poor and slum dwelling populations of Dhaka and the world.

Limitations

Challenges and limitations in data collection

Qualitative and anecdotal observations and feedback from the seven field staff identified the following issues and limitations with data collection (Table 44).

Table 44: Challenges and limitations in data collection

Theme	Specific challenges and limitations
Identifying and tracking women	• In the hospital, we frequently had to ask every woman who delivered whether they were referred from *Manoshi* or not in order to identify women who met the study criteria; this was particularly the case in the government hospitals.

Theme	Specific challenges and limitations
	• The time-intensive Phase 1 interview sometimes required field staff to make two visits to complete the interview. At government facilities, women frequently changed beds between days. Therefore, for an immediate follow-up or to complete interviews, field staff often had to seek her out the following day. If any woman was discharged from the hospital before completing the interview, we had to go to her house to collect remaining information as required.
	• Sometimes, field staff had to take information from respondent's husband or relatives who stayed with her at the hospital, which was time-consuming.
Conducting interview	• The most convenient time for conducting interview in the government hospital was before 10 am or after 12 pm, as the doctors usually visit patients between 10 am and 12 pm. Government hospitals were over-burdened with patients, and most of the time there were two mothers and their neonate(s) per bed. It was frequently difficult to find empty or suitable place to conduct interview, particularly at the government facilities.
	• Most of the respondents were very cooperative. However, there were some complaints against *Manoshi* programme, with respondents citing that they did not get sufficient financial support from the programme as the reason.
Follow-up interview in community	• In Phase 2, our data collectors often had difficulty finding the respondent's house. Sometimes, we did not find them in their documented address, particularly if they had shifted within the study area. Sometimes field staff had to visit respondent's house more than 3 times to reach her.

Other limitations

This was a hospital-based study, such that the rates presented reflect those of a specific population. Though definitive conclusions regarding community rates cannot be drawn from these data, they do sometimes reflect other reported community rates in similar contexts (e.g. postpartum depression, IPV, etc.).

The study population was not randomly selected. Rather, we sought to capture in detail a population who fit specific characteristics related to a large MNCH NGO intervention in an urban area. Conclusions and differences which we identified should not be conclusively generalized; however, many may be relevant to other similar settings – urban slums, Bangladesh, South Asia, etc.

The retrospective nature of our study limited case inclusion. We were obviously unable to interview any women who died or were incapacitated in the intrapartum period, which may have revealed important information regarding women whose course of delivery did not have a positive result, and the associated factors which led to their death.

One major limitation regarding medical care and complications is the dearth of objective medical information we could collect between referral and decision to perform - or not perform - CS. However, the investigators were surprised that even with a moderately large sample size, few differences were found between CS cases and NVD controls. This may itself be an important finding, although we note the likelihood of a Type II error (where differences truly exist but were not found to be statistically significant).

While elucidation of the supply and demand factors leading to CS is tempting, it may well be beyond the scope of this study. We note that 58% of women identified only the doctor as the primary decision-maker for CS, and only 4% included themselves as the decision-maker. The most concerning possibility of this would be that women feel disempowered to make the decision for CS once they are under a physician's care; this could affect care-seeking behavior and continued input into their own care after referral. However, this fact does help dictate areas for further study, focusing on physician attitudes and practice patterns in empowering women to make decision for CS. It could also incorporate study surrounding financial incentives or other incentives to perform CS in ambiguous cases, defensive obstetrics (particularly when considering postdate and delivery after a previous CS), threats of litigation, and ethical perceptions. It could also include more detailed medical information surrounding the antepartum and intrapartum decision(s) to perform CS.

Most of these limitations pertain to the case-control aspect, which sought to demonstrate differences between CS cases and NVD controls. These should not overshadow the important information about overall disease prevalences, incidences, care-seeking behaviours, economic consequences, and postpartum experiences of women referred to the facility by Manoshi in the urban slums of Dhaka, a rapidly-growing and understudied population.

CONCLUSION AND RECOMMENDATIONS

This study demonstrates the medical care and consequences, economic consequences, and social consequences of NVD and CS in facilities after referral by BRAC Manoshi programme. The following are specific recommendations:

- Ensure women have documentation and/or knowledge of EDD as accurately as possible, as nearly all women received antepartum care, but a subset (6%) still could give neither EDD nor LMP. As gestational age is an important component in clinical decision-making, knowledge on actual LMP and EDD might prevent unnecessary referral and CS.

- Ensure women identified as postdate are in fact identified and managed correctly, as "postdate" was a common indication for both referral and CS when women had not yet reached 42 weeks gestational age.

- Focus the training for identifying referral cases particularly toward SKs, POs, and MMWs , as the majority of women were referred primarily by them (64%, 17%, and 16%, respectively).

- Incorporate findings about the rates of common antepartum, intrapartum, and postpartum complications, and indications for eventual CS, to ensure that BRAC staff have adequate training to manage and refer appropriately and skillfully, particularly for common problems.

- Continue encouraging women not to undergo a trial of labour at home, as 9% of women with non-medicine-induced labour pain onset did so.

- After getting referral from BRAC, 10% of women visited other facilities before reaching the terminal facilities and 5% of them underwent trial for normal delivery at those facilities, which contributed to delays in getting definitive delivery care. Though this may have been clinically appropriate at the time, the program should be aware of these decisions by mothers when referring them for urgent or emergency delivery care.

- Consider increasing financial support to mothers, or other alternative interventions, to deter or prevent catastrophic health expenditure and drastic coping mechanisms, especially borrowing and seeking less or no

healthcare. Also, implement programmatic strategies to identify and assist households with moderate to severe household hunger.

- Ensure that women understand the risks, benefits, and reasons for CS before referral, so that they can make an informed and empowered decision regarding CS once they are in the facility. Encourage both BRAC and hospital providers to inform and empower women and their families to allow them to make an informed decision about CS.

- Consider programmatic strategies to address and intervene regarding the high rates of positive postpartum depression screening in women after undergoing both CS and NVD, as well as strategies to identify and offer aid to women who have thoughts of self-harm.

- Consider programmatic strategies to address the women who experience increasing levels of abuse and neglect behaviours in the postpartum period, particularly verbal abuse, lack of physical and emotional support, and humiliation. Also consider strategies to identify the small subset of women for whom their overall familial status has changed, who may require more intensive social and mental support.

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