

Do young mothers get the care they need? Mapping age disparities across the maternal continuum of care using a holistic clustering technique: Preliminary findings

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Abstract

The analysis uses the novel approach of finding clusters of women based on their utilisation patterns across the maternal continuum of care. Cluster analysis is used to identify distinct groupings and allocate women to these groups. Clusters are then related to adolescent status and voucher receipts via multinomial logistic regression controlling for background characteristics. Predicted probabilities of cluster membership are generated for illustration. Four clusters of care utilisation are identified. The High Utilisation cluster is characterised by high use of ANC, delivering in a facility, having an SBA at delivery and receiving Postnatal Care within 2 days of the birth. Other clusters are High utilisation except for ANC, Recommended ANC tailing off and Lowest overall utilisation, characterised by ANC below recommended levels, home birth without an SBA and no postnatal checks. Adolescent women are least likely to be members of the high overall utilisation cluster and most likely to be members of the Lowest Overall Utilisation. This effect is not eliminated by voucher receipt. Adolescent women have lower levels of care utilisation than both young mothers and older mothers, despite higher levels of risk during pregnancy. Voucher, although it increases the overall level of care utilisation, is not sufficient to raise utilisation among adolescent women to parity with older women. The identification of the Recommended ANC, tailing off cluster is also a concern: care needs to be taken to ensure that women progress through the continuum of care.

Introduction

Many of today's 1.2 billion adolescents¹ (ie, people aged 10–19 years) were born around the turn of the millennium, when world leaders first pledged to achieve the Millennium Development Goals (MDGs). These young people have benefitted from improvements associated with the MDGs, including a 47% drop in maternal mortality between 1990 and 2010. However, studies of maternal mortality tend to calculate single mortality figures for women and girls of all ages. Separate estimates for adolescent mothers are needed to allow the assessment of progress, and potential additional risk, in this population. Each year an estimated 16 million women aged 15–19 years give birth, and a further million become mothers before age 15 years. In most countries these adolescent births are concentrated among poorer, less educated women, and early motherhood further compounds disadvantage by disrupting school attendance and limiting future livelihood opportunities.

The potential health, social, and economic disadvantages that adolescent mothers face are widely recognised, and their right to access adequate reproductive health care has been enshrined in a series of important international agreements and documents since 1990 (Nove et al, 2014). That said, giving birth during adolescence remains not only a risk factor for adverse pregnancy outcomes, but also has a negative impact on the future well-being of the mother and infant. Previous studies have reported an increased incidence of adverse maternal and perinatal outcomes, such as low birth weight, preterm delivery, perinatal death, cephalo-pelvic disproportion and maternal death (Glinski et al, 2014). This paper examines the transition of adolescents through the maternal continuum of care, using a novel methodological approach, and evaluates whether the Bangladesh Maternal Health Voucher Scheme has a differential impact among adolescent mothers.

Context of Bangladesh

Bangladesh has made substantial progress over the past decade in maternal and child health. The maternal mortality ratio declined from 574 per 100,000 live births in 1990 to 174 in 2015 (close to the MDG target of 143). The under-five mortality rate went down from 151 per 1000 live births in 1990 to 41 per 1000 live birth in 2013 and thereby achieving the MDG target before the stipulated time (MDG report govt 2015). Despite this progress considerable challenges remain in terms of ensuring comprehensive access to services; barriers such as out-of-pocket expenses delaying care seeking resulting in risk of complications (REF). Nationally representative surveys indicate inequities in access to service among the different population sub-groups, such as the poor, less educated and those residing far from the health facilities (BDHS 2014).

Policy emphasis on continuum

Programmatic investments have been historically directed towards financing individual service components such as skilled attendance at delivery, child vaccination, and family planning. In recent years it has been realized that access to quality healthcare services in pregnancy, childbirth and the postnatal period may yield multiple returns on investment by reducing maternal and neonatal deaths as well as improving child development outcomes (De Bernis et al. 2016, Haezell et al. 2016, Kerber et al. 2007). Thus, maximum utilisation of maternal, neonatal and child health care and nutrition services within the existing health system can be anticipated to expedite progress towards attaining the sustainable development goals (SDGs) for Bangladesh (Lassi et al. 2016). An emphasis on the continuum of care across the spectrum of reproductive, maternal, neonatal, child and adolescent care is exemplified by the Countdown approach of graphically presenting coverage data across the continuum (Talkudar et al. 2014, Lyons-Amos et al. 2017). At global level the Partnership

for Maternal, Newborn and Child Health (PMNCH) now has a key role in catalyzing integrated programmatic investment strategies such as the Global Financing Facility to overcome structural barriers to effective delivery of services (REF for GFF and PMNCH).

Background to voucher scheme

A range of interventions have been tested to overcome barriers to service access among the marginalized groups including those targeting 'demand side' as well as 'supply side' issues. Voucher schemes, a demand side financing instrument, has been introduced in the health sector of a number of low and middle income countries to increase demand for services among targeted groups and are used to reduce OOP for health care for households at risk of not seeking care in the absence of the subsidy (Talkudar et al. 2014). This voucher-based system, or "demand side" financing, is a substitute for the traditional "supply side" approach to financing service delivery and includes a range of interventions that channel government or donor subsidies to service users rather than service providers (Talkudar et al. 2014). These interventions are intended to incentivize certain positive behaviours such as in-facility childbirth or medical check-ups during pregnancy, either through direct cash payments, or by subsidising service providers. Regular antenatal care that allows screening for risk factors, pre-existing medical conditions, and current health status during pregnancy has been found to have significant positive impact on health of the mother and their child. Although many women visit a medical facility during pregnancy, very few do this regularly in the intervals recommended by the WHO (Villar et al. 2001). This contributes to the persistent burden of adverse maternal and newborn outcomes. The voucher encourages women to make use of the full treatment cycle. Further, studies have also shown that beneficiaries of voucher scheme realize the advantage of modern medical facilities and therefore tend to seek care from qualified providers in future rather than going back to the traditional or unqualified care (Menotti et al. 2016).

Global evidence on impact of voucher scheme

Developing countries such as Uganda, Kenya and Pakistan have seen positive impacts on service coverage resulting from implementation of voucher schemes. In Nairobi, Kenya there were significantly greater chances of a facility-based delivery among respondents after the initiation of the voucher programme in comparison to the situation before the programme was launched (Bellows et al. 2012). In South Punjab, Pakistan, it has been seen that women who delivered after the voucher programme started and were sold voucher booklets were significantly more likely to make at least three ANC visits, deliver in a health facility, and make a postnatal visit, than women who delivered before voucher scheme was launched (Agha 2011). Increased facility delivery was also a positive outcome of the maternal voucher scheme programme in Uganda (Eva et al. 2015). The scope for voucher schemes to increase access to maternal and newborn care is confirmed in a systematic review carried out on low and middle income countries. However, this review also stated that poor behaviour of healthcare staff could deter women from using DSF schemes or result in negative experiences (Murray et al. 2014).

Implementation of voucher scheme in Bangladesh

Evidence from 2014 national health and demographic survey shows that births in health facilities has increased to around 37% from 26% in 2011 (BDHS 2014). Home delivery thus remains the preferred choice for majority of the mothers. Health services are not configured to support home based skilled care thus driving a continued reliance on informal healthcare providers, such as traditional birth attendants. This gap in access to skilled care disproportionately affects the poor and those living in rural areas owing to lack of access to affordable health services and limited knowledge of available

services (national health account, BDHS2014). There is evidence of over medicalization of child birth in some settings, especially the extraordinarily high rate of caesarean delivery in urban (38.1%) compared to rural areas (17.6%) (BDHS 2014). Feedback from pregnant women in rural areas confirms that there are uncertainties and reservations around availing institutional care arising from fear of medical intervention (Anwar 2013).

As a programmatic response to improving maternal and child health outcomes in rural areas Bangladesh introduced a voucher scheme in 2007, popularly known as the Maternal Health Voucher Scheme (MHVS). The scheme was initiated as a pilot in 21 sub-districts in 2007, and currently operates in 53 of the 556 sub-districts. A targeted voucher scheme meant for poor pregnant women, the MHVS covers three antenatal care (ANC) visit, delivery at a health facility, one postnatal check, management of maternal complication including caesarean delivery where required, free medicine, cash allowances for transportation, cash incentive to deliver at a health facility. The voucher can be used in both public hospitals and designated private and non-government facilities. Provider facilities and individual staff also receive a payment for each service received by the scheme participants.

Impact and evidence gaps for Bangladesh

Evidence shows that the implementation of the MHVS has substantially increased utilization of antenatal care (ANC), skilled assistance at delivery, and postnatal care (PNC) services. There is also evidence for improved equity in access to maternal health services despite some administrative challenges in terms of disbursement of benefits (Talkundar et al. 2014, Ahmed and Khan 2011, Anwar et al. 2008, Kamal 2016). Notwithstanding the relative gains, absolute levels of utilization remain low even among the voucher recipients, especially with regard to delivery in health facilities. Furthermore, to date evidence for impact on maternal and perinatal health outcomes is limited both at population level and for facility births. With regard to the latter, Hatt et al. (2010) reported a statistically significantly lower rate of stillbirth for births at participating (15.4 per 1,000 deliveries) compared with non-participating facilities (24.5 per 1,000 deliveries). To date, studies have not had sufficient power to identify differences in maternal mortality. It is possible that impact of voucher scheme may extend to non-mandated benefits such as improved coverage of child vaccination, family planning, and optimal infant feeding, which has not been systematically studied.

Quality and service utilization

While the quality of technical provision of maternal and newborn care is vital to prevent and manage complications so as to achieve mortality and morbidity gains, access to facility based care is heavily conditioned by women's experiences of care whether or not technical elements are optimal. A comprehensive framework for the quality of maternal health service provision thus encompasses domains of provision and experience of care (Hulton et al. 2000, 2007). In a setting where home delivery with traditional providers has been the cultural norm, together with social conditions that may restrict women's mobility or access to formal services, the acceptability of service arrangements are critical in framing women's decisions to seek care and the extent to which families and communities endorse such care seeking. It is anticipated that demand side interventions will facilitate access to facility based care but some reports indicate that perceptions and experiences of how care is delivered are sub optimal in the current service context (Anwar 2013).

Research questions

For an intervention to have an effect on adolescents' knowledge, attitudes, beliefs, and behaviour, it must first be able to reach them. Studies suggest that many adolescents, especially those with the

most pressing SRH needs or who are most marginalized or vulnerable, are not being reached by interventions as intended by program planners. Additionally, many first-generation adolescent health programs implemented broad-based interventions intended to reach all adolescents in a given community or catchment area, rather than identifying and targeting those most vulnerable to health and social problems (Chandra-Mouli et al, 2015). This paper aims to find whether the MHVS helps young mother get the care they need as a specific population sub group, and helps to overcome utilisation gaps experienced by younger women. Specifically, we examine the following research questions:

1. What are the utilisation rates of women across the maternal continuum of care, and to what extent are adolescent women disadvantaged?
2. Does the Bangladesh MHVS ameliorate lower utilisation rates for adolescent women?

Methodology

Study Selection and Sites

The study was conducted in two low performing divisions (in terms of maternal health indicators) of Bangladesh – Chittagong and Sylhet. Comparison rates of Sylhet and Chittagong with national rates is given in Table 1. The areas under Chittagong division are situated in the southeast part of the country including both coastal and hilly regions of the area. The areas under Sylhet division are situated in two settings, *haor* (a wetland ecosystem) and hilly areas. From the two divisions 6 upazillas (sub-districts) were randomly selected from voucher (4 areas) and non-voucher areas (2 areas) for the purpose of our study. Like many other parts of Bangladesh, agricultural is one of the major economic activities of the villagers in all the study areas. People are also engaged in work related to wood industry and fishing due to the proximity to the sea, *haor* and forest. The study population is conservative in terms of religion and openness to modern ideas, with low levels of secular education. The literacy rate among the population aged 7 years or older is lowest in Sulla (32.0%) and highest in Srimangal (44.0%) and is even lower among women compared to men.

In the Chittagong division, from a total of 11 voucher areas, 2 sub districts (Ramu and Teknaf) were selected as intervention areas. From the rest of the 101 non-voucher areas in the division, 1 sub-district (Chakaria) was selected as the comparison area. All 3 selected sub-districts in the Chittagong division fall under the district of Cox's Bazar. For the purposes of this analysis, we conduct an initial investigation based on the Chittagong division only: data collection from the Sylhet division was not complete when analysis was conducted, and results on the full analysis will be presented in subsequent publications.

Household listing, respondents and Sample survey

All 6 sub districts were divided into two categories – municipality and non municipality areas. The non municipality area was further broken down into two parts – one village which was within 5 kilometres of the Upazilla Health Post (UHC) and the other that was more than 5 kilometres away. The villages were chosen using the 'probability proportional to size' (PPS) technique.

We interviewed women aged 15-49 years who has had a live birth in the last two years and had at least one child aged 0-23 months for the purpose of the study. Sample size was calculated assuming a 10% increase in the facility delivery which currently stands at 31% (1) and 95% confidence interval (CI) with 90% power. A total of 7197 households (Chakaria = 2418, Ramu=2389, Teknaf=2390) were listed including all women aged 15-49 years. From the total households, 1200 were randomly selected from municipality, non municipality areas and distant villages. Within these households, 1944 women (Chakaria = 624, Ramu = 685, Teknaf = 600) were identified as eligible for data collection (i.e., ever-married women age 15-49 and gave livebirth with two years from the survey).

Data collection and Quality Control

A team of 20 interviewers collected the field data and four supervisors and one statistician supervised the data collection process. Overall guidance was given by a health economist and a demographer. Responses were recorded directly on tablets and as logics were built into the system it reduced the likelihood of errors in data entry. A quality control team consisting of 1 quality control officer and 3 re-interviewers maintained the quality of the data. To detect any anomalies, the team re-visited 5% of the households, chosen randomly, within 2 days of data collection by the field workers. Later on, the supervisors and the relevant field workers together sorted out any inconsistencies in the collected data. All the filled-up questionnaires were manually checked for completeness and for any inconsistencies. Subsequently, computer-based data editing procedures were applied to ensure the quality of data.

Table 1 Comparison of MNCH Indicators in Sylhet and Chittagong division with national rates

MNCH indicator performance in Chittagong and Sylhet division (BDHS 2014 and BMMS 2010)			
Indicators	Chittagong	Sylhet	National
At least 1 ANC from medically trained provider	66.3	53.1	63.9
At least 4 ANC	28.2	21.7	31.2
Assistance at delivery by qualified doctor	43.9	27.1	42.1
Facility delivery	22.6	35.2	37.4
PNC for mother within 2 days of delivery from qualified provider	36.3	23.4	36.4
No PNC checkup	61.0	75.1	60.6
No PNC checkup of child	60.3	75.4	63.5
Infant mortality rate	36.0	55.0	38.0
Maternal mortality ratio	186	425	194
Severe Stunting	14.1	19.8	11.6
Wasting	15.6	12.1	14.3
Underweight children	36.0	39.8	32.6

Method

While there is existing literature dedicated to examining components of maternal care, there are a number of methodological deficiencies with this work. Much literature evaluates separate parts of

the continuum in isolation. Whilst this gives us a detailed understanding of the care practises and client behaviours within that part of the continuum- for example, examining either the determinants of use of part of the continuum of care (e.g. Bolam et al., Magadi et al 2006) or providing strong evidence for the positive return on investment for each stage of the continuum (Borghi et al., Manader et al. 2004)-it does not allow us to evaluate care as a whole, nor to draw inferences about the quality of care across the entire MNCH process.

Recognising this, some studies have evaluated the coverage of care across multiple dimensions of the continuum of care. This is a distinct improvement, since it allows us to gain understanding of the continuum from a holistic perspective and evaluates multiple stages of the care process. For instance, there has been much analysis of the effect of the correct number of antenatal visits on the subsequent use of skilled attendants at birth (Guiliani et al. 2012, Adijwanou and Legrand 2013). Although this accurately captures one transition this gives us little information regarding the whole continuum beyond the two stages under examination.

This paper takes the approach of analysing the entirety of the maternal continuum of care as mandated within the MHVS, building on previous attempts to measure care across the continuum (Talkudar et al. 2014, Lyons-Amos et al. 2017). Cluster analysis is employed since this allows the formation of meaningful groupings of care utilisation across the continuum of care using indicators for ANC, delivery and postnatal care. Indicator variables are created for ANC (whether a woman had the recommended number of ANC visits; whether a woman had some ANC care but too few visits); delivery (whether the woman had an SBA present; whether the birth took place in a facility) and post natal care (whether the mother received a post natal check within 2 days of the birth). All of these variables take the form of binary contrasts, taking the values 1 if the woman received the care indicated and zero if not. A measure of dissimilarity is then created where women with similar levels of care utilisation have smaller dissimilarity and women with different care utilisation have higher levels. Dissimilarity for this analysis is based on Ward's linkage. Hierarchical cluster analysis is then performed on this dissimilarity measure to allocate women to clusters based on minimising the within cluster dissimilarity. The number of clusters is decided using both dendograms and the Duda-Hart stopping rule, which provides a measure of the optimal number of clusters based on minimising the within-between cluster variance in the response profile. The cluster analysis is performed using the `cluster` function in Stata 13.0 for Windows.

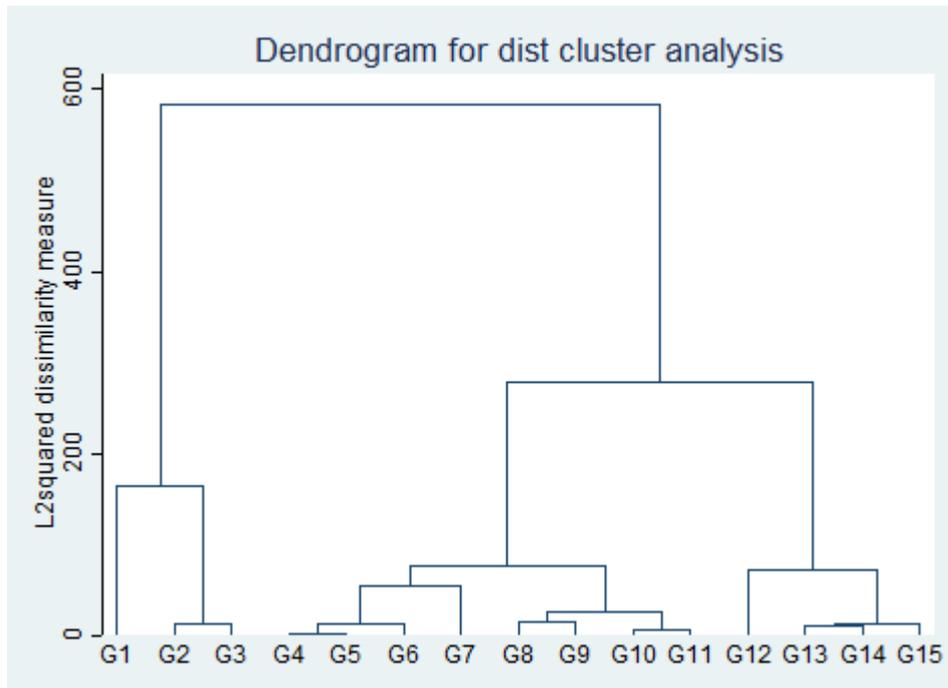
Once clusters within the data are identified, the cluster is then used as the response variable within a multinomial logistic regression to allow identification of the key factors predicting cluster membership. Model building starts by predicating cluster membership based on the age categorisation of the woman. Following this, we introduce a variable to capture the effect of voucher receipt, and test for a significant interaction. This allows us to see whether the voucher is able to remove any potential differentials in care utilisation between age groups. Background control variables of asset quintile (as a proxy for socioeconomic status), educational attainment, rural/urban status, and upazila. This ensures that our results are robust to confounding. On selection of the final model, predicted probabilities of cluster membership are generated to aid interpretation by age group. Control variables are set to their sample proportions when generating predicted probabilities.

Results

Number of clusters

Figure 1 presents the dendrogram for hierarchical clustering for up to 20 cluster solutions. From this, we identify 4 distinct subgroups within the population and proceed with a 4 cluster solutions

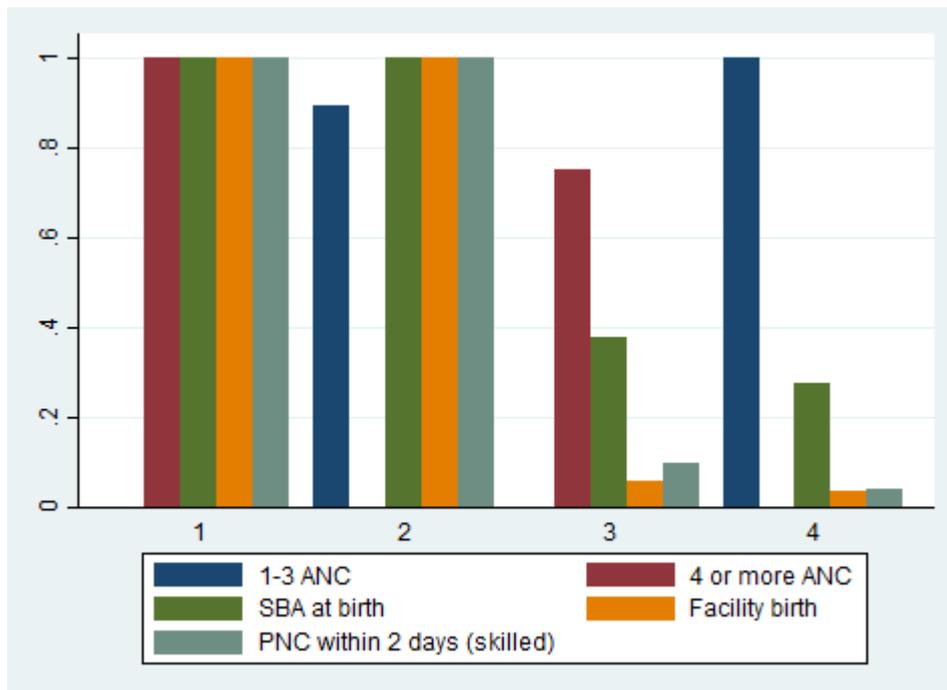
Figure 1: Dendrogram for 2 to 20 cluster solutions



Cluster profiles

Figure 2 presents the cluster profiles for the 4 clusters extracted across the indicators for the maternal continuum of care.

Figure 2: Cluster profiles of service utilisation of maternal continuum of care



Cluster 1 is characterised by high levels of utilisation across the continuum of care, and is termed the **High utilisation** cluster. Women in this cluster have universal utilisation of ANC, with all women having at least 4 visits. Similarly, all women have an SBA present, and give birth in a facility. Finally women in this cluster all have a PNC check within 2 days of birth. This cluster accounts for 21.8% of the sample

Cluster 2 is similar to the first cluster, with the exception of ANC care, and is thus termed **High utilisation except for ANC**. 89% of women within this cluster have some form of ANC, but low recommended levels (1-3 ANC checks). 11% have no ANC at all, and no woman within this cluster has the recommended number of ANC checks. However, utilisation across the rest of the continuum of care is high, with all women having and SBA present, as well as correctly timed postnatal care. This is the smallest cluster at 13.5% of the sample.

Cluster 3 is characterised by women with the currently number of ANC visits, but little other care utilisation and is terms the **Recommended ANC, tailing off** cluster. ANC care within this cluster is characterised by a reasonably high proportion of women (75%) with the recommended number of visits, although roughly 1 quarter of women within this cluster have no ANC care. However, the level of care utilisation declines dramatically after this stage of the continuum of care with only 37% of women in this cluster having an SBA present at birth. The vast majority of birth takes place in the home, with only 5.8% delivering in a hospital. Postnatal checks are also very low in this cluster at 9.8%. This cluster accounts for 31% of the sample

The final cluster represents the **Lowest overall utilisation**. No woman in this cluster has the recommended number of ANC visits, but there is evidence of some ANC care in insufficient quantity. However, only 27% of this cluster have an SBA present at delivery, and only 3.2% deliver in a facility. PNC is similar low at 3.8%. This is the single largest cluster in the sample, including 33.2% of women.

Regression analysis and predicted probabilities

Table 2 presents the predicted probabilities for each of the estimated models. There is a significant effect of age category on one logit of the multinomial logistic regression in Table 2, indicating differential care utilisation patterns by age group (Model 1). The addition of voucher to the model significantly improves model fit, and leads to an attenuation of the effect of age category- indeed at this intermediate stage age category loses significance (Model 2). There is no significant interaction effect, indicating an homogenous effect of the voucher scheme on care utilisation (Model 3). If the presence of controls, the effects of the both age category and the voucher indicator are significant at a 5% level (Model 4). Predicted probabilities from this model are generated by age group to aid interpretation and are presented in Figure 3. Each panel represents an age group in the analysis, with panel a representing the adolescent group of mother age under 20, panel b representing young mothers aged 20-24 and panel c representing older mother (25 and older)

Table 2: Regression models for cluster membership

	Model 1: Age category			Model 2: Voucher indicator			Model 3: Interaction			Model 4:		
	High utilisatio n across CoC	High utilisatio n except ANC	Recommende d ANC, tailing off	High utilisatio n across CoC	High utilisatio n except ANC	Recommende d ANC, tailing off	High utilisatio n across CoC	High utilisatio n except ANC	Recommende d ANC, tailing off	High utilisatio n across CoC	High utilisatio n except ANC	Recommende d ANC, tailing off
<i>Age category (ref=Adolescent)</i>												
Young women	0.41	0.13	0.14	0.22	-0.32	0.16	-0.01	-0.52	-0.01	0.27	0.06	0.17
Older women	1.07**	0.36	0.53	1.01	-0.21	0.81	0.45	0.16	0.77	1.01*	0.08	0.25
<i>Voucher receipt (ref=No)</i>												
Yes				0.91**	0.44	0.18	0.45	0.27	-0.08	-0.06	0.01	0.01
<i>Age category x Voucher receipt</i>												
Young women x Yes							0.72	0.65	0.63			
Older women x Yes							1.20	-13.12	0.16			
<i>Education (ref=)</i>												
2										0.68*	-0.17	0.03
3										2.44**	1.35	0.89
4										16.67	-0.27	14.44
<i>Wealth quintile (ref=1)</i>												
2										-1.45**	-0.27	-0.15
3										-1.47**	-0.84	-0.60
4										-1.82**	-0.82	-0.71
5										-3.01**	-1.41*	-0.66

<i>Satype (ref=1)</i>												
2										-0.30	-1.29	0.05
3										-0.87	-0.35	-0.49
Constant	-0.69	-0.98	-0.15	-1.02	-0.90	-0.23	-0.86	-0.86	-0.16	1.10	0.21	0.46

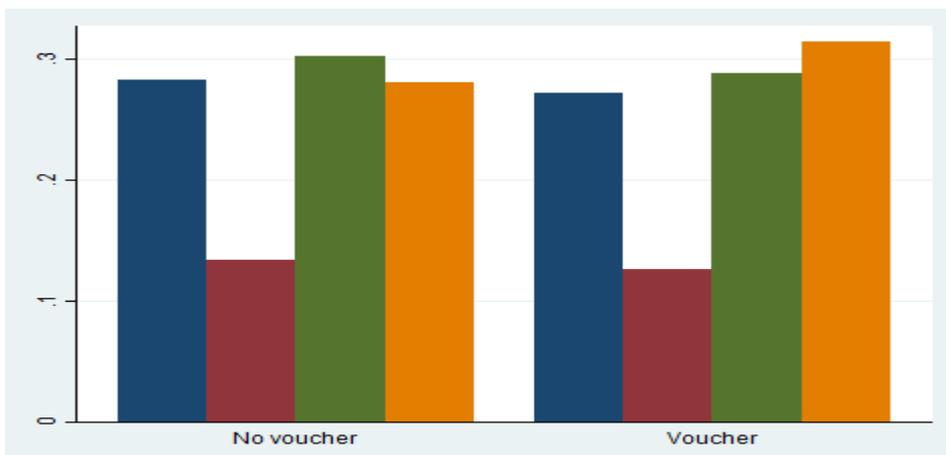
Notes: * p<0.05 **p<0.01

Figure 3: Predicted probabilities of cluster membership for final regression model for a) adolescents (under 20), b) young women (20-24) and c) older women (over 24) by receipt of voucher status

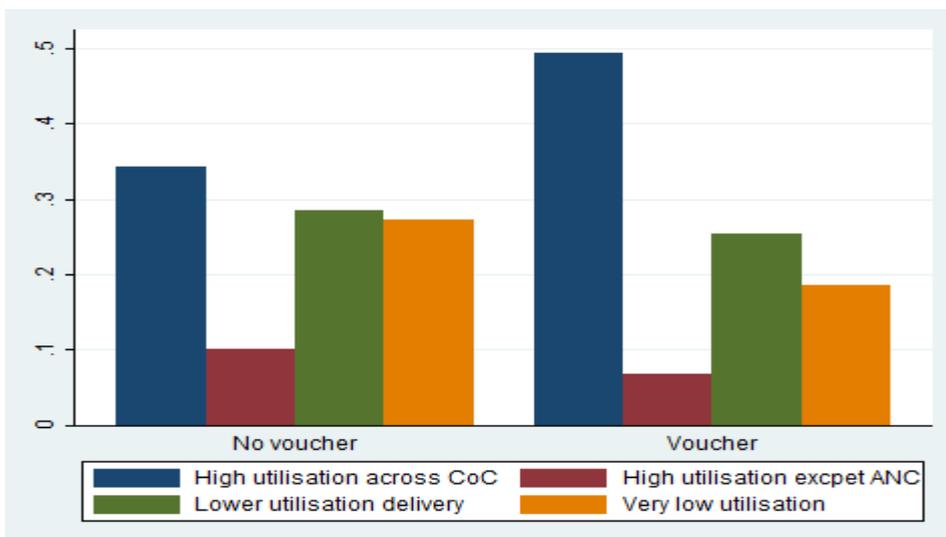
a)



b)



c)



Most variation between clusters comes from the predicted probability of being in cluster 1 (High utilisation) or cluster 4 (Lowest utilisation). The prevalence of cluster 1 is lowest among adolescents, at 18%. The prevalence of the highest utilisation of care increases for young women, 23.79%, and is highest amongst older women 32.7%. This trend is reversed for the lowest care utilisation cluster, which is highest among adolescent women (36.62%), but declines for young women (31.5%) and is lowest among older women at 22.4%. There are no strong trends for clusters 2 (High Utilisation except ANC) and 3 (Recommended ANC, tailing off).

Conclusions and discussion

This paper uses a novel methodological approach to evaluate the pattern of utilisation of the maternal continuum of care among adolescents compared to both young women and older women. While existing studies have examined elements of the continuum of care in isolation, evaluation of care utilisation across the entirety of the continuum of care is vital to ensure that negative outcomes are minimised (De Bernis et al. 2016, Haezcell et al. 2016, Kerber et al. 2007). This is particularly true for adolescents who suffer not only from elevated clinic risk during pregnancy but also greater difficulty in accessing care (Nove et al. 2014, Glinski et al. 2014). We use a cluster analysis to identify meaningful groups within our data using indicators of care utilisation across the continuum of care building on previous analytical techniques which visualised the continuum holistically (Talkudar et al. 2014, Lyons-Amos et al. 2017).

Our analysis revealed four distinct clusters of care utilisation within the data. The patterning of these clusters in terms of care utilisation is informative from a policy perspective in its own right. The High Utilisation cluster captures consistent utilisation of services across the continuum of care, High Utilisation except for ANC captures generally high utilisation, but too few ANC visits. The Recommended ANC Tailing Off cluster represents a pattern of drop out, while Low Utilisation shows a similar drop off in care albeit from a pattern of too few ANC checks. This highlights one of the major contributions of the clustering approach: conditioning only on one of the indicators alone would not allow us to distinguish overall patterns (for example, conditioning on ANC utilisation gives no discriminatory power between clusters 1 with consistent use and cluster 3 characterised by drop off). Where continuity of care across the continuum is key, the ability to identify drop off in care utilisation is of key importance from a policy perspective. In particular the existence of cluster three should be a major focus: high levels of ANC are, for a substantial proportion of Bangladeshi mothers, not sufficiently translated into continuation to other services. One potential chokepoint is the costs of attending a facility relative to voucher reimbursement: Keya et al. (2013) find that the average spend for delivery transport being 432 Taka (\$6.17) compared to the 100 Taka (\$1.4) reimbursement from the voucher.

As well as identifying patterns of care utilisation, this analysis linked these to adolescent status to identify potential differences by age group. We find that adolescents are much less likely to have the highest utilisation of care than older women, and while schemes such as the MHVS tend to increase the probability of membership of the Highest Utilisation cluster, this effect is not sufficient to overcome age related disparities, with youngest women being the most likely to receive low levels of care across the continuum. Care should be taken to ensure that adolescent women, at elevated risk of pregnancy complications are sufficiently able to access maternal care services, right across the continuum of care.

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