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Does antenatal care make a difference to safe delivery? A study in urban Uttar Pradesh, India

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Evidence to support that antenatal screenings and interventions are effective in reducing maternal mortality has been scanty and studies have presented contradictory findings. In addition, antenatal care utilization is poorly characterized in studies. As an exposure under investigation, antenatal care should be well defined. However, measures typically only account for the frequency and timing of visits and not for care content. We introduce a new measure for antenatal care utilization, comprised of 20 input components covering care content and visit frequency. Weights for each component reflect its relative importance to better maternal and child health, and were derived from a survey of international researchers.

This composite measure for antenatal care utilization was studied in a probability sample of 300 low to middle income women who had given birth within the last three years in Varanasi, Uttar Pradesh, India. Results showed that demarcating women's antenatal care status based on a simple indicator – two or more visits versus less – masked a large amount of variation in care received. Logistic regression analyses were conducted to examine the effect of antenatal care utilization on the likelihood of using safe delivery care, a factor known to decrease maternal mortality. After controlling for relevant socio-demographic and maternity history factors, women with a relatively high level of care (at the 75th percentile of the score) had an estimated odds of using trained assistance at delivery that was almost four times higher than women with a low level of care (at the 25th percentile of the score) (OR = 3.97, 95% CI = 1.96, 8.10). Similar results were obtained for women delivering in a health facility versus at home. This strong positive association between level of care obtained during pregnancy and the use of safe delivery care may help explain why antenatal care could also be associated with reduced maternal mortality.

Introduction

Antenatal care is named as one of the four pillars of the Safe Motherhood Initiative,[1] but its relative contribution to maternal health has been under lively debate. Recent comprehensive reviews of studies have concluded that many routine procedures have very little effect in reducing maternal mortality and morbidity, although a few, such as screening for poor maternity history, have been ascertained as beneficial.[2,3,4,5] The difficulties in demonstrating an effect of safe motherhood interventions on maternal health outcomes, particularly mortality, have been documented.[6] The emphasis on the performance of specific medical components, however, undermines the potential impact of antenatal care as an integral part of women's health.

Indirect effects of antenatal care attendance are difficult to assess, but important to consider. Elements that either comprise part of care content, such as health education, or occur as a result of seeking care, such as personal experience acquired by using the system, have not been adequately investigated. These aspects may foster skills that result in saving women's lives. Routine antenatal visits may raise awareness about the need for care at delivery[7] or give women and their families a familiarity with health facilities that enables them to seek help more efficiently during a crisis.[8]

Numerous studies have examined the relationship between antenatal care utilization and maternal outcomes. Randomized controlled trials that assign women to different protocols have found little difference between intervention and control groups[4,9] but these studies do not include populations of women with little or no antenatal care. Retrospective studies in Ethiopia,[10] India,[11,12] Nigeria,[13] Senegal[14] and Zimbabwe[15] found that a lack of antenatal care was an important risk factor for maternal death. Other studies observed an association between antenatal screening for poor obstetric history combined with proper referral and a lower risk for maternal death.[16,17] Although some of these studies have methodological weaknesses related to, not controlling for, potential confounding factors, the effects were typically very pronounced, suggesting that an association is likely to exist.

A problem underlying all areas of research on antenatal care is the manner in which utilization is measured. Antenatal care status is typically characterized by the number or timing of visits. Indices of care that combine these two elements and adjust for gestational age have also been formulated. Based on the protocols particular to individual studies, the scale of the resulting measure is subsequently divided into adequate versus inadequate care obtained.[18,19,20,21] One study included a factor for whether or not women had received tetanus immunization as part of its index.[22] Only one other study has

combined a count of visits with a number of care content features.[23] By basing measures solely on the number of visits, women may be grouped together for analysis when their antenatal care status differs markedly. The need for measures that account for the content of care in order to more accurately represent antenatal care status has been recognized in developed country settings.[19,24] In developing countries this issue is key, as there is tremendous variation in the content and quality of antenatal care received by women due to factors related to facilities and users themselves.

Since an estimated 90% of maternal deaths can be prevented with timely medical intervention,[25] ensuring quick access to appropriate services when obstetric emergencies arise is one of the most important aspects of safe motherhood in developing countries.[26] In urban areas, women and services may be close to each other, but selecting a trained attendant at the time of delivery is critical to bringing them together in time. It has been suggested that one of the best things antenatal care could accomplish would be to influence women to select a trained attendant at birth.[2] The few studies that have explored this relationship present differing findings. An association between the use of antenatal care and health facility delivery was observed in Ethiopia[10] and Zaire.[27] McDonagh[2] provides a review of other studies that found no such association.

A number of studies in various regions of the world have found important socio-demographic characteristics which influence the likelihood of using professional health care at birth. Most of these studies were based on populations located in both urban and rural areas. Distance to services – or rural residence as a proxy for distance – demonstrated a very strong, negative effect on the use of delivery care. Parity of the mother was also found to have a negative association with the use of such care, while a positive relationship was observed for economic and educational status.[18,27,28,29,30] Age patterns were inconsistent. Some studies found a positive correlation with older ages,[28,29,30,31] while others found a curvilinear relationship with age.[18,32] Other determinants of safe delivery care use were problems experienced during delivery, exposure to media, women's employment status and women's perception of risk associated with birth, which were all positively correlated with the use of trained assistance at birth.[27,31]

The present study controls for these factors while examining the relationship of antenatal care utilization with the use of safe delivery care among poor to middle income women in an urban area of Uttar Pradesh (UP), India. We introduce a composite measure for antenatal care use based on 20 different input components. Each of these components was assigned a weight based on a five-point scale representing its importance to positive maternal and child health outcomes. This measure is used in logistic regression analyses to investigate the effect of pregnancy care use on the likelihood of using safe delivery care.

Data and methods

The data were collected in November 1995 – April 1996 as part of a larger study on maternal health care utilization among poor to middle income women living in Varanasi, UP, India. Varanasi is the third largest city in UP; the 1991 population was 1.1 million.[33] Typical of urban India, a multiplicity of health services are provided by the Central and State governments, municipal bodies, charity organizations and a large private sector.[34]

Demographic and health outcomes in UP lag behind most other states in India. In 1991, the crude literacy rate in UP was 42% and in India overall, 53%.[35] Fertility is higher than in most other states. UP has the second highest infant mortality rate (UP: 99.9/1000 live births, India: 78.5/1000) and the third highest child mortality rate (UP: 46.0/1000 live births, India: 33.4/1000). A similar picture exists for maternal health care statistics: relative to most of India, UP is worse off.[36]

A probability sample of 336 poor to middle income households was drawn using a two-phase cluster design that covered urban Varanasi. An exclusively urban environment was chosen to control for the distance to health services. Households in the sampling area were within 15 minutes walking distance to a government or charity facility. Women were eligible for the study if they had delivered a child within three years of the date of interview and were either Hindu or Muslim. The three-year recall period has been used to collect similar types of information in larger surveys pertaining to maternal health.[37,38] Other religions were excluded from the study because these comprise only 3% of the total urban population in Uttar Pradesh.[39]

The sampling strategy was based on that developed for evaluating the World Health Organization's (WHO) Expanded Programme of Immunization (EPI).[40] The sampling frame for the study was a list of households in Varanasi by locality, maintained by the Municipal Corporation. Among a total of 94 clusters – each consisting of four or five geographically contiguous localities – a self-weighted random sample of 43 clusters was drawn. Household selection was done according to the modification of the WHO EPI process recommended by Bennett *et al*.[41] in order to capture as much intra-cluster variation as possible. A household was chosen near the middle of each cluster as a starting point. After a successful interview, five households on one side of the street were passed before checking another home for an eligible woman; this process was repeated until seven households were successfully interviewed in each cluster. If two or more eligible women resided in one household, the youngest one was chosen for interview. The refusal rate was 10.4%. One household had to be excluded at the end of data collection because the woman's antenatal care status had been misclassified during interview, leaving a sample size of 300. All interviews were conducted in Hindi by the first author and the female research assistant from Varanasi.

Socio-demographic data were collected on all individuals residing in the household and a full pregnancy history was recorded for eligible women. Questions on antenatal care use referred to only the most recent birth to minimize recall bias. The median length of time between this birth and interview was 13 months, with a maximum of 37 months; in 75% of cases, this birth had taken place within 24 months previous to the interview. Details on antenatal care pertained to screenings

and interventions which could have occurred anytime during pregnancy, and components that were specific to the initial, median and final visits. Women were probed for all content features with simple descriptions. A two-phase pilot study was conducted to test the wording of the questionnaire. Women clearly understood the meaning of the questions and explanations. There were very few hesitations in answering and the information was usually corroborated by another individual who had participated in the woman's care. As is the case with all retrospective data based on self-report, the responses pertaining to antenatal care received may have been subject to recall bias. The differential in recall periods or complications experienced during pregnancy could have influenced how women reported pregnancy-related care.

The composite measure for antenatal care utilization

Following data collection in Varanasi, a panel survey was conducted from July – August 1996 among maternal and child health researchers from six international health institutes around the world. The survey was conducted according to the Delphi method,[42] a way of deriving consensus of opinion in situations when the true answer to a problem is ambiguous and dependent on personal judgment. The method has been applied in a variety of contexts including verbal autopsy,[43] eliciting community-based information on health problems[44,45] and exploring practitioners' views on sensitive topics.[46] Thirteen individuals representing a variety of backgrounds (obstetricians, paediatricians, midwives and reproductive health specialists), who were known to us for their experience in the field, were asked to rate each of 20 different components of antenatal care (shown in Appendix 1). Panelists were asked to use their professional judgement to score each component in terms of its importance to positive maternal and child health outcomes in the Indian setting, as if it were the only thing a woman received during her pregnancy, relative to the other components listed. Items were rated on a scale from 0–4, reflecting degrees of importance (not at all important, a little important, somewhat important, moderately important and very important).

Three researchers did not return their ratings, and one who did not interpret the purpose of the survey in a manner consistent with the remaining participants was excluded, leaving a total of nine participants. Most disagreement between participants occurred with regard to the importance of performing blood pressure readings and checking the foetal heartbeat. Scores for both a blood pressure reading during the first visit and a foetal heartbeat check during the last ranged from 0–4; both standard deviations were 1.77. There was high agreement on other items, such as tetanus immunizations and patient education. The range in scores for tetanus immunizations was only 2 points (sd = 0.49). Patient education also had a range of 2 points for the median and the final visits, with similarly small standard deviations (0.53 and 0.38, respectively). The variation in agreement on the rest of the items fell between these two extremes.

An antenatal care score was generated for each woman by summing the weights of the 20 items shown in Appendix 1. These weights were derived from averaging the responses of the nine researchers from the Delphi panel survey for each item. For each component of care received during the most recent pregnancy that led to a birth, the respective weight was added to the score, otherwise a zero was scored for that item. The only exception to this was made for the item pertaining to referral for facility delivery for high risk. Both high risk women (according to the criteria in Appendix 1) who were referred and low risk women were scored 3.89 points, the mean for that item. High risk women who were not referred were scored zero.

Six of the nine researchers responded to a second round of the same survey, after receiving information on the results of the first round. There was a small decrease in the variation on items in the second round, although the set of scores resulting from the two rounds were highly correlated ($r = 0.969$ comparing nine versus six participants, $r = 0.974$ comparing the same six researchers for both rounds). The averages resulting from the first wave of the survey (shown on Appendix 1) were used as weights for the present analyses since they reflected the contribution of three more experts in the field.

Statistical analyses

Two indicators were used to model safe delivery care. The first pertained to whether the delivery was attended by a health professional versus another person, regardless of delivery site (home or facility-based). A health professional, or trained attendant, was defined as a person with formal medical schooling; a doctor, midwife or nurse. Traditional birth attendants were not included in this category. Women in the study clearly differentiated a 'midwife', using the English word itself, from a '*dai*', a local woman known to deliver babies. All facility-based births were attended by a health professional. This individual was usually a nurse. Women who delivered at home with a health professional – usually a midwife but sometimes a nurse – were also classified as such. The second indicator was based on delivery site – at home versus at a health facility.

A number of covariates were examined in the analyses. The measure for antenatal care utilization was the continuous score, as described. Economic status was indicated by whether the walls of the family dwelling were made of cement versus any other type of material. Dwelling materials other than cement demarcate the poorest proportion of the sample. Rather than focusing on the woman's level of schooling, educational status was measured as the average of all members of the household age 15 or above. One previous study used a similar measure along with women's education.[18] Since women in this region of India rarely make health-related decisions independently,[47] the educational level of the household was deemed more important than that of the individual woman. Employment status indicated whether or not women earned money through work performed inside or outside the home. Other variables explored in the analyses were religion, maternal age, parity and conditions relating to maternity history such as complications, still births, child deaths, the previous use of care and reported problems during the current pregnancy and birth. As a proxy for the perception of risk associated with delivery, women were asked whether

they personally knew any woman who had died during or shortly after childbirth.

Preliminary analyses studied the marginal associations between the two safe delivery care variables and the covariates. Next, a taxonomy of nested logistic regression models were fit to investigate factors that predict the use of safe delivery care. For multivariate analyses, previous research has demonstrated the importance of controlling for age, parity, economic and educational status when examining the determinants of delivery care. Other variables were retained if they were statistically significant at the 0.05 level via Wald chi-square tests or when their removal caused an appreciable change in the remaining regression coefficient estimates. Tests for relevant interactions were also conducted. Goodness-of-fit tests were conducted to assess the appropriateness of the final models.[48] Logistic regression coefficients were estimated assuming independence among responses from women in the same sampling cluster. Then, robust variance estimates[49] were calculated for the regression coefficients to accommodate the effects of intracluster correlation. The odds ratios, 95% confidence intervals and p-values reported are all based on these robust variance estimates. Statistical analyses were conducted using SAS version 6.12[50] and Stata version 5.0.[51]

Results

Socio-demographic characteristics of women

The characteristics of the sample were what would be expected from a low income, urban population in UP. Almost a third of the sample was Muslim (29%), 75% of women lived in extended households and the remainder lived in other types of arrangements. Almost all women were married (97%) and ranged from age 16–42 at the time of their most recent delivery. Two-thirds of the women (66%) could read.

Maternal and child health statistics were comparable to the findings of other surveys conducted in UP.[38,39] Almost a quarter of all women (n = 72) had experienced at least one child death; more than a third of these women (n = 28) had lost two or more children. Almost three-quarters of women (n = 214, 71%) used a health professional for their most recent delivery, 20% used a traditional birth attendant and another 8% were assisted by a relative or friend; 1% of the women gave birth alone. Only 59% of women (n = 176) delivered this child at a health facility. Among the 300 most recently born children, 8 had died by the time of interview. Among the remaining 292, 74% had been fully immunized for their age and 8% had received no immunizations.

Variation in antenatal care use

Among the 300 women in the sample, the composite antenatal care measure took on values ranging from 0 (no care utilized at all) to 57.0 (the maximum total of all the component weights). Figure 1 shows the frequency distribution of the scores among the study population and depicts the variation in the levels of care obtained by women. The median score for the sample was 29.6 points. Women scoring above the 75th percentile (41.4 points) received most or all of the care recommended, while women scoring below the 25th percentile (10.1 points) received minimal or no care. Thus the interquartile range was 31.3 points.

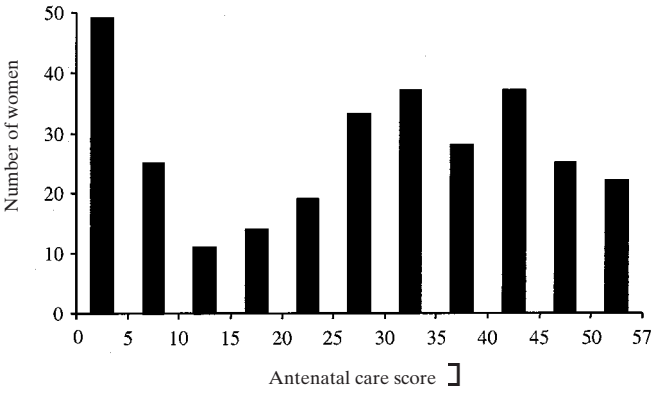

Figure 1. Histogram of antenatal care scores, grouping the frequency distribution of women into five-point categories, except for the highest group

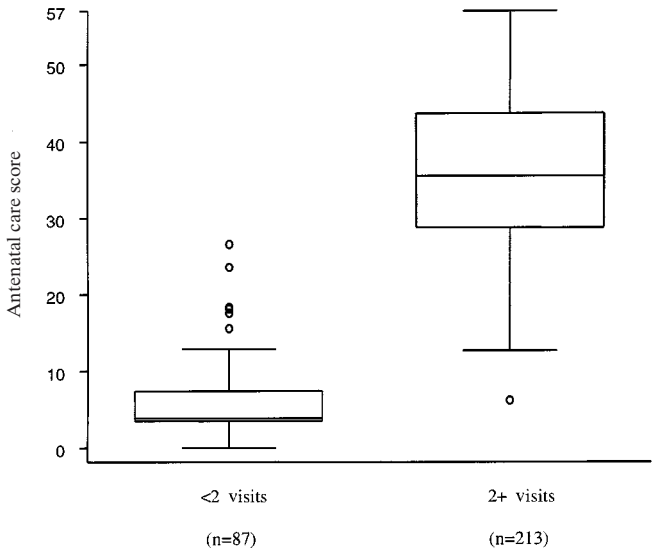

Figure 2. Boxplot of antenatal care scores for women with less than two clinic visits versus those with two or more
[The boxes represent the interquartile ranges, the horizontal line in the boxes is the median score, the whiskers extend to the upper and lower adjacent values (the largest data point ≤ the data point that falls above the 75th percentile at 1.5 times the interquartile range and the smallest data point ≥ the data point that falls below the 25th percentile at 1.5 times the interquartile range, respectively). More extreme values are plotted separately.]

Figure 2 compares the distribution of antenatal care scores for women with less than two visits (n = 87) and those with at least two visits (n = 213). Although the distributions of scores are different, there is some overlap. In addition, women with two or more visits show a very wide distribution in antenatal care scores. This reflects the large amount of variation in care obtained.

Table 1. Percentages of women using trained assistance or a facility for their most recent birth, as a function of socio-demographic characteristics (n = 300)[1]

Socio-demographic characteristics	Safe delivery care		
	No. of women	Trained attendant %	Facility delivery %
Economic status (based on dwelling type)			
Low	103	53.4***	41.8***
High	197	80.7	67.5
Mean household education			
Low (lowest quartile)	78	50.0***	39.7***
Moderate (middle 50%)	143	69.9	53.9
High (highest quartile)	79	94.9	86.1
Religion			
Muslim	86	64.0	57.0
Hindu	214	74.3	59.3
Woman is employed			
No	261	72.4	61.3*
Yes	39	64.1	41.0
Age at most recent birth			
16 – 19	39	79.5*	74.4*
20 – 29	200	73.0	59.5
30 – 34	37	64.9	48.7
35 – 42	24	54.2	41.7
Previous births			
None	47	91.5**	87.2**
One or more	253	67.6	53.4

[1]p-values are based on logistic regression models of either trained attendant or facility-based delivery on the respective variable named, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Use of safe delivery care

Relationships between selected socio-demographic characteristics and the type of care women used for their most recent delivery are shown in Table 1. Women who were of higher economic and educational status, younger age and those with no previous births were more likely to use safe delivery care. Only slightly larger proportions of Hindu women used safe delivery care. Employed women were less likely to use trained assistance. These women were more likely to be of lower educational and economic status, two factors negatively correlated with the use of maternal health care in these data.

The relationship between maternity-related characteristics and delivery care is shown in Table 2. The factor that might raise awareness of risk during childbirth – knowing someone personally (relative, friend or neighbour) who died around the time of birth – was not associated with delivery care utilization. Those who had experienced a child death or who had not experienced problems during a previous birth were somewhat less likely to use safe delivery care, but the remaining factors were more important. The correlation between experience with a child death and the lower use of care is probably due to the low socio-economic status of these women, which would also be associated with a lower utilization of child health services, and thus a higher risk of child death. Women with a higher level of antenatal care were much more likely to use safe delivery care, with the most dramatic difference between those in the lowest quartile and the rest. Women who experienced problems during the current pregnancy and delivery, and those who had previously used a trained attendant or health facility for a delivery were more likely to use trained assistance.

The effect of antenatal care utilization on safe delivery care

The baseline logistic regression models controlled for factors that demonstrated associations with delivery care in previous research: age, education, economic status and parity. The positive association between higher economic and educational status with using trained assistance at birth persisted. Collinearity between age and parity precluded the use of both factors together in one model. When parity was added, the age effect was nullified. A categorical parity variable indicating whether women had at least one previous delivery or not demonstrated a much stronger effect than a continuous parity measure. Women experiencing their first birth were much more likely to obtain professional health care at delivery. Based on the results of the preliminary analyses, the effects of other potential socio-demographic and maternity-related

Table 2. Percentages of women using trained assistance or a facility for their most recent birth, as a function of maternity history and care characteristics (n = 300)[1]

Maternity characteristics	Safe delivery care		
	No. of women	Trained attendant %	Facility delivery %
Knows woman who died in childbirth			
No	241	70.5	58.1
Yes	59	74.6	61.0
Problems during current pregnancy			
No	151	65.6~	54.3
Yes	149	77.2	63.1
Problems occurred during current birth			
No	227	67.4**	52.0***
Yes	73	83.6	79.5
Level of antenatal care use			
Low (lowest quartile)	75	37.3***	22.7***
Moderate (middle 50%)	151	81.5	69.5
High (highest quartile)	74	85.1	73.0
At least one child dead[2]			
No	181	71.3~	58.0*
Yes	72	58.3	41.7
Problems during a previous birth[2]			
No	190	64.7~	50.0~
Yes	63	76.2	63.5
Safe delivery care for a previous delivery[3]			
No		18.6***	16.3***
Yes		82.5	72.5

[1]p-values are based on logistic regression models of either trained attendant or facility-based delivery on the respective variable named, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, ~ $p < 0.10$.
[2]Among 253 women with one or more deliveries previous to the most recent birth.
[3]Among 253 women with one or more deliveries previous to the most recent birth. Use of safe delivery care for a previous delivery refers to even-use of a trained attendant (no n = 59, yes n = 194) for association with trained attendant at the most recent birth, or to previous use of a health facility for delivery (no n = 86, yes n = 167) for association with facility delivery at the most recent birth.

confounders were examined while controlling for economic level, education and parity. The only characteristics that demonstrated a statistically significant association with delivery care were problems experienced during the current pregnancy and delivery. When both variables were added to the model, the effect of problems experienced during pregnancy did not demonstrate a significant association with delivery care, and the removal of this factor did not cause an appreciable change in the remaining parameter estimates.

Table 3 presents the results of two final logistic-regression models fit to explain the determinants of using safe delivery care. A higher economic and educational level, and the occurrence of problems during delivery all showed positive, significant associations with the likelihood of using a trained attendant, after controlling for the other factors in the model. Since education is a continuous variable, the presented odds ratio refers to a difference of one year in educational level between households. Based on a five-year difference between households, women from more educated homes have an estimated odds of using trained assistance that is more than two times higher (OR = 2.14, 95% CI = 1.16, 3.92) than those from less educated homes.

When the variable for antenatal care utilization during the current pregnancy was added to the model, the effects of the other predictors were slightly attenuated, but all retained similar levels of statistical significance. After controlling for all the factors shown in Table 3, there was a strong, positive association between the level of antenatal care obtained and the likelihood of using a trained attendant at delivery. Women with a high level of antenatal care (at the 75th percentile) have an estimated odds of using a health professional at the time of delivery that is almost four times higher than women with a low level (at the 25th percentile) (OR = 3.97, 95% CI = 1.96, 8.10). No interactions between covariates were found. Since age showed no significant association with delivery care when controlling for the other factors, and its

Table 3. Logistic regression results for the likelihood of using safe delivery care as indicated by the use of a trained attendant regardless of delivery site, and by delivery in a health facility (n = 300)[1]

Determinants of care use	Safe delivery care			
	Trained attendant		Facility delivery	
	odds ratios	95% CI	odds ratios	95% CI
Economic status				
Low	1.00	–	1.00	–
High	2.21*	(1.15, 4.23)	1.89*	(1.05, 3.41)
Mean household education (per year)	1.16*	(1.03, 1.31)	1.13**	(1.04, 1.24)
Previous births				
≥ 1	1.00	–	1.00	–
None	2.70~	(0.91, 8.01)	3.72**	(1.68, 8.24)
Problems occurred during delivery				
No	1.00	–	1.00	–
Yes	2.61*	(1.12, 6.11)	3.94***	(1.93, 8.04)
Level of antenatal care obtained				
Interquartile range difference (31.3 points)	3.97***	(1.96, 8.10)	2.72**	(1.43, 5.16)

[1]***p < 0.001, **p < 0.01, *p < 0.05, ~p < 0.10.

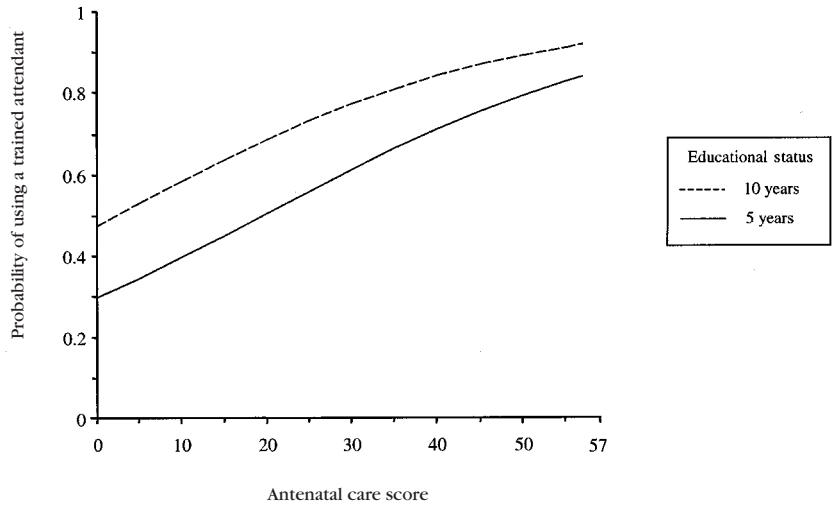

Figure 3. Fitted probability of using a trained attendant at delivery, as a function of the level of antenatal care obtained during pregnancy and educational status. Calculations are based on the model presented in Table 3, and assume a woman of low economic status, at least one previous birth and no problems experienced during delivery.

removal caused less than a 2% change in the remaining parameter estimates, it was not included in the final model. The same was true for all other covariates not included.

Results were very similar for the model for facility-based versus home delivery (also shown in Table 3). The effects of first delivery (OR = 3.72, 95% CI = 1.68, 8.24) and problems experienced during birth (OR = 3.94, 95% CI = 1.93, 8.04) were more pronounced in this model. Controlling for all factors shown, the level of antenatal care obtained during pregnancy still had a strong, positive association with the likelihood of delivering in a health facility (OR = 2.72, 95% CI = 1.43, 5.16, for the interquartile range difference in antenatal care score).

Figure 3 illustrates the dramatic effect of antenatal care use on the use of a trained attendant at delivery. The predicted probability of giving birth with a health professional based on different levels of antenatal care obtained is depicted, comparing women with ten versus five years of education,

while controlling for all other factors in the trained attendant model in Table 3. For both highly and moderately educated women, the likelihood of delivering with a trained attendant is much higher for women who obtain a high level of antenatal care score than for those with less care. The fitted probability for women with a low level of antenatal care (at the 25th percentile of the score – 10.1 points) and low education is only 40%, while for similar women with a high level of care (at the 75th percentile of the score – 41.4 points) it is 72%. The figures for highly educated women are 59% and 85%, respectively.

Since the effect of previous use of delivery care on current use was so pronounced in the preliminary analyses, a model (not shown) to control for this factor, that included all the factors shown in Table 3, was fit for the population of women who had experienced at least one previous delivery (n = 253). The continuous indicator for parity was used. There was a strong, significant association between the use of a trained attendant for a previous delivery and current use of one (OR = 13.45, 95% CI = 6.42, 28.22). Although some of the socio-demographic effects were attenuated, the magnitude of the antenatal care effect decreased only slightly and was still statistically significant (OR = 2.51, 95% CI = 1.22, 5.17, for the interquartile range difference in antenatal care scores).

Discussion

These data demonstrate that after controlling for important confounding variables, the use of care during pregnancy among lower to middle income women in Varanasi positively influences the likelihood of using trained assistance at the birth. Women who obtained higher levels of antenatal care were more likely to use safe delivery care than those with lower antenatal care levels, in both contexts measured. This effect persists at various levels of economic status, education and parity, and whether or not they experienced problems at delivery or had previously used safe delivery care. The results provide further support for the argument that antenatal care is an integral part of maternal health care.

This study presented a measure for antenatal care use that accounts for both visit frequency and timing, as well as content features. Rather than demarcating adequate versus inadequate care (an assessment requiring direct indicators of service quality and an evaluation of individual risk status), the purpose of the measure was to provide a basis of comparison between women receiving better or worse care. This comparative perspective is lost in the majority of research on antenatal care, which has neglected to include information about visit content in its measures. Information on health care received is a proxy for quality of care, in that it reflects the availability of treatment, tests and preventive procedures to a given population.[52] Very little research has been conducted on the content of antenatal care received by women in developing countries, which would help focus policy and programmatic interventions on the gaps in existing health care systems. Furthermore, given that nearly all previous studies on the impact of antenatal care use on health outcomes have classified women's antenatal care status using visit frequency and timing, it is likely that important relationships have been missed. The only other study that used an antenatal care measure that incorporated care content found that a low number of visits and poor content of care both independently contributed to the risk of preterm delivery, but the effect of the latter factor was much stronger.[23]

The components and weights for the measure in the present study were formulated in reference to women in urban North India. The measure could probably be extended for use elsewhere in South Asia, but individual component weights may differ for women in rural areas. Using this type of measure in other regions would necessitate a selection of input components and assigned weights that relate to the problems of that area. For example, measures in developed country settings would not assign any importance to tetanus immunization.

The multivariate analyses revealed several important determinants of safe delivery care among this population of women in Varanasi that have also been observed elsewhere.[18,28,30,31] Economic status had an impact, especially in the case of using a trained attendant. Having a midwife or nurse at home is more expensive than a traditional birth attendant, and it may also be easier to get facility-based care that is cheaper. Women are more likely to get care for their first delivery than for others that follow. Concerns with obtaining care for a first delivery are probably related to factors such as fear of the unknown or excitement over a first child. The stronger effect of problems experienced during delivery in the facility model would be expected, since women would more likely go to a facility for help rather than call for someone at home, given the proximity of services.

The present study did not use the antenatal care measure to evaluate its effect on maternal and foetal outcomes directly, which was a limitation imposed by the small sample size. Using the same type of measure might clarify some of the present debate on the importance of antenatal care to maternal and child health. A larger survey could investigate the effect of antenatal care use on foetal deaths. Maternal morbidity is more difficult to measure through retrospective self-report, but some conditions are more amenable to this type of investigation than others.[53,54] Rather than a general index of care, the selection of input components and their weights should reflect the risk markers of the outcome to be measured. The combination of components and respective weights for a study focusing on maternal conditions would differ from one evaluating foetal outcomes.

Despite this limitation, the general index was very useful for demonstrating the relationship between the use of antenatal care and delivery care. This relationship may be explained by a number of factors. Women may act on advice given during antenatal visits regarding the benefits of safe delivery care and the risks associated with not using it. However, the issue is likely to be more complex. Direct experience with health services over time is the most effective way of obtaining knowledge about how to engage professional services. Women may grow more comfortable with professional

health care through progressive exposure over the length of their pregnancy. All these factors may contribute to an expectation of engaging professional health care for birth. The strong effect for the continued use of delivery care in the model for the subsample of women demonstrates the same trend: whether for future deliveries, or for the delivery that follows a particular pregnancy, women who utilize professional health care for maternity events tend to keep using it within the urban context, where care is easily accessible.

Conclusions

Despite the availability of safe delivery care in Varanasi, almost 30% of poor to middle class women there use untrained assistance at birth. Delivery care needs to be viewed within a given cultural milieu. Birth is an intense event that is located within a construct of traditional beliefs, personal preferences and views about reproduction and health. A number of studies observed that women were averse to using health professionals at birth because their practices did not correlate with local expectations.[55,56,57] Methods of raising awareness about the benefits of safe delivery care should be sought, but services also need to be placed within a context acceptable to women and their families.

Recent findings indicate the need for changing the composition of antenatal care. Interventions and screenings of questionable benefit could be replaced with other types of health care important to women in their reproductive years, such as screening for sexually transmitted diseases and education pertaining to their prevention. Further research should be undertaken to investigate which components of antenatal care are really beneficial, particularly in developing country settings, where randomized controlled trials are rare. This must include an assessment of aspects of antenatal care which are usually ignored in both research and practice, such as patient education.

There is no question that the use of a health professional at the time of delivery reduces the risk of maternal mortality and morbidity.[25] The results of this study show that antenatal care utilization is an important determinant of safe delivery care, after controlling for a number of factors known to influence the use of care during pregnancy and childbirth, which could account for some of the unexplained association in studies that have detected an effect of antenatal care use on a lower risk for maternal mortality. This suggests that enabling women to get better antenatal care will increase the use of safe delivery care as well. There is little doubt that this effect of antenatal care is of benefit to women and their children.

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Appendix 1. Factors comprising the antenatal care measure and the weights used to construct it, based on the panel survey responses of nine researchers. Each component was rated on a scale of importance (0 = not important at all, 1 = a little important, 2 = somewhat important, 3 = moderately important, 4 = very important) to maternal and child health, relative to the others listed.

	Average weights for measure
Antenatal care visits	
At least two antenatal visits	3.44
Initial visit made within first 4 months	2.89
Final visit made at or after 8 months	3.89
Occurred sometime during the pregnancy	
Two tetanus toxoid immunizations	3.56
Antenatal card/record used during pregnancy	2.78
Medical/maternity history recorded	3.00
Referred for facility delivery if high risk*	3.89
Initial visit content (made ≤ 4 months)	
Blood test for anaemia screening	1.56
Blood pressure reading	2.00
Prescribed or given iron/folate	3.67
Was given advice/education	3.22
Content of median visit(s)	
Blood pressure reading	1.78
Prescribed or given iron/folate	3.44
Was given advice/education	3.33
Final visit content (made ≥ 8 months)	
Internal examination	0.67
External (abdominal) examination	3.44
Blood pressure reading	2.67
Foetal heartbeat checked	1.67
Prescribed or given iron/folate	2.44
Was given advice/education	3.67

*Women considered at high risk were those who had one or more of the following: history of foetal death, previous caesarean section, six or more previous deliveries, below age 16 or above age 40 at the time of delivery.