RESEARCH ARTICLE

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Deciphering the Association of Antenatal Care Visits and Pregnancy Outcomes from South Africa

Akm Monjurul Hoque, Samaya Buckus, Maariyah Hoque, and Guido Van Hal

ABSTRACT

Optimal antenatal care (ANC) opens the windows of opportunities for timely identification and interventions for the prevention of maternal and foetal morbidity and mortality. The objectives were to determine the antenatal care utilisation patterns and its association with adverse pregnancy outcomes. A retrospective cohort study of all women giving childbirths between January 2018 to September 2019 at a midwife obstetric unit was undertaken. All variables were significant on bivariate analysis ($p<0.05$) were included in the multivariate model and the significant results were expressed with adjusted odds ratios (OR) and p values. Most (94.4%) of the pregnant women received antenatal care, 76% had $\geq$ 4 and only 24.9% had $\geq$ 8 ANC visits. Half (52.5%) of them had booking visit at or before 20 weeks gestation. There was no maternal death. Low birthweight (LBW), stillbirth and neonatal death rates were 9%, 17 and 7 per 1000 live births respectively. The number of antenatal visit was a significant predictor for stillbirth, neonatal death and LBW. Women who did not attend ANC were 22 times (OR=21.8, 95% CI: 2.51: 189.24, p=0.005), 17 times (OR=17.31, 95% CI; 1.9:157.1, p=0.001) and 11 times (OR=11.0, 95% CI; 5.4:22.19, p=0.000) more likely to have stillbirths, neonatal deaths and LBW respectively. Increasing the number of ANC visits decreased the likelihood of stillbirth, neonatal death and LBW. Few pregnant women received $\geq$ 8 ANC visits. Higher numbers of ANC visits were positively associated with decreased occurrences of LBW, still births and neonatal deaths. Strengthening the ANC services should be prioritised in SA.

Keywords: Kwadabeka CHC, low birthweight, neonatal death, pregnancy outcome, stillbirth.

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I. Introduction

Optimal antenatal care (ANC) is an important intervention that provides opportunities in identifying and intervening against various risks of pregnancies and remedies for mothers and unborn babies [1]. The objective of person-centred ANC is to ensure positive experiences for pregnant women through well-being and prevention of maternal and fetal morbidity and mortality [2], [3]. Therefore, the lives of pregnant women and their neonates are largely dependent on the utilization of ANC services [4]. With this view, South Africa (SA) has implemented the policy that Maternal and Child healthcare services are free of charge in public health facilities for all pregnant women and children under 6 years to ensure availability and accessibility [5]. There has been much progress made regarding the reduction of the institutional maternal mortality ratio (MMR) from 189 deaths per 100 000 live births in 2009 to 99 deaths per 100 000 live births in 2019 [6]. SA is a signatory to the United Nation's (UN) new initiative of sustainable development goals (SDG), and adopted the strategies to improve women, children and adolescents' health aiming in reducing further maternal and neonatal mortality and morbidity [7]. Accordingly, one of the changes made, is that the number of ANC visits that a pregnant woman needs during the pregnancy has increased from a minimum target of four to eight visits. However, more visits are recommended for pregnant women at high-risk. The new schedule of ANC visits should be initiated within the first trimester of gestation and subsequent visits are scheduled at 20, 26, 30, 34, 36, 38, and 40 weeks of gestation age (GA) [3]. The implemented changes of ANC services are aiming to improve ANC quality through improved screening, detection and appropriate management of pregnancy-related complications [8].

The causes of maternal deaths reveal that lack of ANC visits, care and or delay in seeking ANC contribute to higher maternal deaths [6]. A report indicates that 33% peri-natal mortality those occur in SA at birth are largely due to late ANC booking and or no initiation of ANC [9]. The epidemiological reports have identified similar associations of negative pregnancy outcomes such as preterm births, stillbirths and neonatal deaths with poor ANC uptake from other parts of the globe [10]-[13]. It is also reported that

increased ANC visits in the third trimester help to identify and manage hypertension-related complications those lead to still births [14], [15]. Recent studies also report that the number of ANC visits are found to have a dose-dependent association with preterm births [12], [13]. A population-based study showed that the risk factors for preterm births are 2.4 times higher among those who receive<1 ANC visit compared to pregnant women who have received >3 visits [12]. Reference [16] reports that higher proportions (94%) of pregnant women attend antenatal care, 76% receive four or more antenatal visits and virtually all (96%) pregnant women deliver at health facilities. However, significant variations are found between health districts, provinces, rural versus urban and different sociodemographic groups, time of ANC initiations, number of visits and health facility delivery rates [17]. These ANC indicators appear good in SA; however, the pregnancy outcomes remain poor as there are other reports of increasing trends of low birthweight (LBW) (<2.5 kgs) deliveries and a higher rate of MMR (536 per 100 000 live births) in SA [17]. Reference [18] reports that maternal and perinatal mortality rates remain high in rural areas. Despite the political commitment and administrative efforts, the utilization of ANC services by pregnant women remains a major public health challenge, as the majority of pregnant women (96%) are found to attend ANC late (after 12 weeks of pregnancy) and a large proportion of them (70%) initiate ANC after 20 weeks of GA [19], [20]. Presently there is no report that measured the compliance to the new ANC visit target of 8 visits and pregnancy outcomes in SA. We thus concluded that there is a gap in the knowledge with regard to the utilization of antenatal care visits and pregnancy outcomes. Therefore, the objectives are to determine the ANC utilization patterns and its association with adverse pregnancy outcomes (maternal death, LBW, stillbirth and neonatal deaths).

II. Materials and Methods

A. Study Design

This was a retrospective cohort study of all women who gave childbirth in a midwife obstetric unit (MOU) during the study period.

B. Study Setting

The study was undertaken in a public health facility running an MOU, Kwadabeka community health centre (KCHC), a Primary Health Care (PHC) setting in the KwaZulu-Natal Province (KZN), SA. KCHC is situated in a peri-urban community of Kwadabeka in the eThekwini district. It serves over 150 000 predominantly black population. Most of them are poor, living mainly in informal types of dwellings and having a well-built cultural tie with the rural people of KZN and Eastern Cape Provinces. There are 7 other fixed PHC clinics under the administration of KCHC. Antenatal and post-natal services are provided at all PHC clinics and KCHC using the SA national protocol and guidelines [5]. Accordingly, risk pregnancies are identified and categorised into low-, intermediate- and high-risk pregnancies. The intermediate-risk pregnancies are referred to KCHC for ANC from PHC clinics. High-risk pregnancies are referred to hospitals for antenatal care and childbirths [5]. KCHC manages all low- and intermediate-risk pregnancies during the antenatal period. The high-risk pregnancies are referred to hospitals from PHC clinics for ANC and delivery. KCHC provides delivery services to all low-risk pregnancies by midwives. Delivery services at KCHC are available 24 hours a day. According to the national guidelines, the unit is responsible for making antenatal care available to all pregnant women at the booking visit, treatment of pregnancy-related common problems, management of labour and delivery services, postnatal check-ups, and the management of emergencies during the antenatal and delivery services with referrals to the appropriate hospitals in eThekwini district. There are over 800 deliveries annually at KCHC.

C. Population and Sampling

The sample for this study was all women who gave childbirths from January 2018 to September 2019 at KCHC. Women who gave birth at home or on the way to the clinic (BBA) and presented to KCHC for maternal postnatal care and care for the neonates were registered in the birth register and included in our study.

D. Data Collection

Data were abstracted from the KCHC labour ward "birth register" using Microsoft excel 365. The register was the only official register for all births or deliveries, referrals and discharges. The register contained among other variables the name, age, parity, number of ANC visits received, GA at the time of ANC initiation and delivery, HIV and syphilis status (positive or negative), APGAR scores in 1 and 5 minutes and birth weight of the baby and pregnancy outcomes regarding maternal deaths, live births, still-births and neonatal deaths.

E. Data Analysis

Data were analysed using SPSS 22.0 (SPSS Inc, Chicago, IL, USA). The demographics, obstetric and baseline outcome variables were summarized using descriptive summary measures: expressed as mean with standard deviation (SD) for continuous variables and per cent categorical variables. We measured utilization of ANC in terms of frequency of ANC visits (categorized into 0, 1-3, 4-7 and $\geq$ 8 visits). Parity was categorized as nil, 1-2, 3-4 and $\geq$ 5. The GA was categorized at the time of ANC initiation (< 20 and $\geq$ 20 weeks) and at delivery ($\leq$ 32, 33-36 and $\geq$37 weeks). Cross table analysis using the Pearson Chi-square test (X^2) was used to identify variables significantly associated with outcome variables (1 = yes, 0 = no for LBW, stillbirths, and neonatal deaths respectively). All statistical tests were performed using two-sided tests at 0.05 level of significance. Logistic regression (backward) analysis was undertaken with the significant demographic, obstetric and ANC variables with the outcome variables. For regression models, the results were expressed as an effect (adjusted odds ratios (OR) for binary outcomes), corresponding two-sided 95% confidence intervals (95% CI), and associated p values. P values <0.05 were considered significant.

F. Definitions

Maternal death was defined as the death of a mother during labour, delivery, and post-partum period in KCHC.

Stillbirth was referred to the birth of a dead foetus (either macerated or fresh) weighing more than 1000 g or after 28 weeks of gestational age.

Low birth weight was defined as the birth of a baby with a weight of less than 2500 g irrespective of gestational age.

Neonatal death in this study was defined as death of a live birth baby after delivery in the facility within 6 hours.

G. Ethical Considerations

Ethical clearance was obtained from the uMgungundlovu Health Ethics Review Board (Reference no. UHERB 015/2020). Permission was sought from the KZN Provincial Health Research Committee and written permission was obtained from the management of the KCHC to use the birth register data for the study. Secondary data were used, and hence informed consent was waived.

III. Results

A total of 1411 women gave childbirths at KCHC which formed the study subjects. There were 3 women who had twin deliveries. The frequency and percentages of study variables are presented in Table I.

The teenage pregnancy rate was 15% and more than half (58%) of the mothers were between 20 to 29 years of age. Half of them (49%) had parity between 1 and 2. Most of the pregnant women (76%) had 4 or more antenatal visits. However, only a quarter (24.9%) of these women had 8 or more ANC visits. The mean number of ANC visits was 5.48 (SD: 2.9). The rates for BBA and un-booked for ANC were 2.9% and 5.6% respectively. Over half (52.5%) of them had a booking visit before 20 weeks of GA. The prevalence of HIV and syphilis infections at birth were 44.3% and 2.1% respectively. LBW rate was 9%. The total number of stillbirths was 24 resulting in a stillbirth rate of 17/1000 live births. A total of 10 neonatal deaths estimated the neonatal death rate of 7/1000 live births. There were no maternal deaths during the study period.

In cross table analysis, the independent variables (Table 2) found significantly associated with outcome variables were the number of ANC visits, gestational age, HIV and syphilis infections ($p<0.05$). The significant variables were entered into a step-by-step logistic regression analysis to identify the predictors for outcomes variables of the study. The logistic regression output (Table 3) for pregnancy outcomes showed that women who were un-booked for ANC were 22 times (OR=21.8, 95% CI: 2.51:189.2, p=0.005), 17 times (OR=17.31, 95% CI: 1.9:157.1, p=0.001) and 11 times (OR=11.0, 95% CI; 5.4:22.1, $p<0.001$) more likely to have stillbirths, neonatal deaths and LBW respectively compared to those who had ≥ 8 antenatal visits. Antenatal visits between 1 and 3 showed 13.6 times (OR=13.6, 95% CI; 1.7:107.6, p=0.013) more likely to have stillbirths compared to ≥8 ANC visits. The number of antenatal visits between 1-3 and 4-7 was 3.5 times (OR=3.56, 95% CI;1.9:6.6, p=0.000) and 1.8 times (OR=1.9, 95% CI;1.03:3.2, p=0.037) more likely to have LBW compared to women had ≥8 ANC visits.

TABLE I: Frequency Distribution Of All Study Variables

Variables	Frequency	Percent (%)
Age (n=1411)		
≤ 19 years (teenage pregnancy)	210	14.9
20 - 24 years	407	28.8
25- 29 years	412	29.2
30- 34 years	268	19.0
=> 35 years	114	8.1
Parity (n=1406)		
Nil parity	431	27.3
1-2 parity	778	49.3
3-4 parity	180	11.4
=>5 parity	17	1.1
ANC visits (n=1355)		
No visit (un-booked for ANC)	74	5.4
1-3 visits	251	18.5
4-7 visits	698	51.6
=>8 visits	332	24.5
Mean number of ANC visits (SD)	5.48 (2.9)	
Booking visit ≤ 20 weeks (n=1392)	729	52.4
Gestational age (n=1343)		
≤ 32 weeks	51	3.8
33-36 weeks	158	11.8
≥37 weeks (term)	1134	84.4
BBA (n=1407)	41	2.9
HIV positive (n=1407)	623	44.3
Syphilis positive (n=1407)	30	2.1
Pregnancy outcomes (n=1410)		
<2.5 kg (Low birth weight)	142	9.0
=>2.5 kg	1268	80.4
Stillbirths	24	1.6
Neonatal deaths	10	0.7
Still Births	17/1000 live births	
Neonatal death rate	7/1000 live births	

TABLE II: CROSS TABLE ANALYSIS OF DEMOGRAPHIC AND ANTENATAL CARE VARIABLES WITH PREGNANCY OUTCOMES

Variables	Low birthweight			Stillbirth			Neonatal death		
	Yes (%)	No (%)	P-value	Yes (%)	No (%)	P- value	Yes (%)	No (%)	P- value
Age									
≤ 19 years	19.7	14.4		25.0	14.7		20.0	14.9	
20 - 24 years	26.8	29.1		41.7	28.6		50.0	28.7	
25- 29 years	26.8	29.5	0.05	12.5	29.6	0.11	20.0	29.3	0.51
30- 34 years	14.1	19.5		8.3	19.2		10.0	19	
=> 35 years	12.7	7.5		12.5	8.0		0.0	8.2	
Parity									
Nil parity	35.5	30.2		30.5	37.5		50.0	30.5	
1-2 parity	53.9	55.5	0.30	55.5	50.0	0.84	40.0	55.5	0.60
3-4 parity	10.6	13.0		12.8	12.5		10.0	12.8	
=>5 parity	0.0	1.3		1.2	0.0		0.0	1.2	
Antenatal visits									
0	19.1	4.4		21.7	5.6		44.4	5.6	
1-3 visits	26.5	17.5	0.00	43.5	18.1	0.00	33.3	18.4	0.00
4-7 visits	42.6	52.3		30.4	51.6		11.1	51.4	
=>8 visits	11.8	25.8		4.3	24.7		11.1	24.5	
Gestational age									
≤ 32 weeks	32.6	0.7	0.00	68.4	2.8	0.00	50.0	3.4	
33-36 weeks	36.4	9.1		21.1	11.6		12.5	11.7	0.00
≥ 37 weeks	31.0	90.2		10.5	85.6		37.5	84.9	
HIV status									
Positive	50.7	43.5	0.01	37.5	44.5	0.49	20.0	44.4	0.12
Negative	49.3	56.5		62.5	55.5		80.0	55.6	
Syphilis status									
Positive	1.8	5.0	0.01	2.2	0.0	0.45	10	2.1	0.08
Negative	98.2	95.0		97.8	100		90	97.9	

TABLE III: LOGISTIC REGRESSION OUTPUTS FOR LBW, STILLBIRTHS AND NEONATAL DEATHS

Dependent Variables	Significance (p value)	Adjusted OR	95% CI for OR	
			Lower	Upper
LBW deliveries				
No. of ANC visit	0.00			
0	0.00	11.01	5.46	22.19
1-3	0.00	3.56	1.91	6.62
4-7	0.03	1.83	1.03	3.26
≥ 8		1		
Constant	0.99	0.00		
Stillbirth				
No. of ANC visit	0.00			
0	0.00	21.80	2.51	189.34
1-3 visit	0.01	13.68	1.74	107.60
4-7 visit	0.26	3.33	0.40	27.19
≥ 8 visit		1		
BBA (No)	0.03	0.06	0.01	0.41
BBA (Yes)		1		
Birth weight > 2.5 kg	0.00	0.04	0.01	0.20
Birth weight < 2.5 kgs		1		
Constant	0.00	0.03		
Neonatal death				
No. of ANC visit	0.00			
0	0.00	11.01	5.46	22.19
1-3 visits	0.00	3.56	1.91	6.62
4-7 visits	0.03	1.83	1.03	3.26
≥ 8 visits		1		
Constant	0.99	0.00		

Reference groups are for antenatal visits ≥ 8, BBA (Yes), Birth weight (< 2.5 kg)

IV. DISCUSSION

The maternal service coverage in SA is comparably better than other sub-Saharan African countries [16]. We found a similar rate of 95% pregnant women had ANC initiations. Only half (52.5%) of them had a booking visit before 20 weeks of gestation. This was lower than the national target of 70% and also lower than other findings from an urban setting in SA, where the rate was 76% [5], [16]. A much higher rate of first-trimester booking was reported (90%) in developed countries such as Norway, Switzerland, Netherlands, and New Zealand compared to SA [21], [22].

Our study estimated that only a quarter of pregnant women received 8 or more ANC visits and the mean number of visits were 5.48 (SD: 2.9). This is lower but similar to the finding of a report on ANC visits after the implementation of the new target of ANC visits in SA. This review report showed the mean number of ANC visits was 5.9 (SD: 2.3) [23]. However, the study did not report on the proportion of pregnant women that received the new target of 8 ANC visits. Therefore, our study is the first in SA, reporting that the new indicator of 8

visits was achieved in only 25% of pregnant women. Implementation of the eight antenatal care visits model posed new challenges to both the health-care system (infrastructure and human resources) and to pregnant women (frequent visits require time off from work, extra transport cost to pregnant women) in SA and other settings.

Initiating ANC before 20 weeks of gestation enables more opportunities for optimal care timeously [24]. Our findings revealed that of the pregnant women (52.5%) that booked before 20 weeks gestation, 22.6% achieved the target of eight ANC contacts. This finding was comparatively lower than the rate found in a study in China, where 39.9% of pregnant women received at least 8 ANC visits during pregnancy [25]. Unplanned pregnancy, being asked to come back later after presenting too early for the ANC booking visit and having a child for the first time are some of the known significant contributing factors for the pregnant women from a peri-urban area presenting late and subsequently having suboptimal (< 8) ANC visits [26]. The changes for the eight ANC visits had been recently implemented, and as such little research had been done on achieving the optimal ANC visits in SA. Taking into consideration that this is the first study in SA to evaluate if the 8 ANC visit target has been met. It is thus difficult to compare our results to the findings of another study in SA. Achieving the 8 ANC visits during pregnancy, implemented by the WHO, undoubtedly warrants further research in SA.

We found an LBW delivery rate of 9% in our study which is comparable to the rate of 8.4% found earlier in the same health facility [27]. Studies conducted in Abu Dhabi and Iran both reported LBW rates of 9.4%.[28], [29]. However, the LBW rate in our study is lower than the rates found in other African countries such as Ethiopia (10.4%), Sudan (12.5%) and Nigeria (16%) [30]- [32]. These differences could be explained by the nature of the studies. Delivery at tertiary hospitals is highly likely to be associated with high preterm births because of managing complicated pregnancies, such as preterm birth, unlike the current study, which was community-based first or lowest level of healthcare facility and manages low-risk pregnancies [31], [32].

The stillbirth rate (1.6%) of our study was lower than the rate found in the population-based study conducted among low-and middle-income countries [33]. However, the stillbirth rate of our study was similar to the rate (1.4%) found in Argentina [33]. Maternal bacterial infections, diabetes, high blood pressure and recreational drug use are some of the contributing factors to stillbirths found in an earlier study in SA [34]. To decrease stillbirths, these factors need to be controlled. An audit on the timing and causes of stillbirths in SA reported that both hypertensive disorders in pregnancy and unexplained stillbirths were the most common adverse outcomes during the third trimester of gestation between 32 and 38 weeks [35]. The newly implemented increased ANC contact schedule in the third trimester of gestation would thus help to identify and prevent stillbirths [35], [36]. Birth defects or umbilical cord accidents were known to lead to stillbirths and early neonatal deaths. The advent of sonographic diagnosis and maternal serum assay methods made it easier to diagnose any birth defect more than before. However, these services were not readily available at a MOU.

Studies found that 71% of neonatal deaths can be avoided if the coverage and quality of ANC and intrapartum care are improved [37]. Less than three ANC visits were found to be associated with increased risks of perinatal mortality in Australia [38]. Studies of women with low-risk pregnancies showed that, in limited-resource settings, reduced ANC visits did not have any effect on neonatal intensive care unit (ICU) admissions, but they were associated with an increase in perinatal mortality [39].

Negative birth outcomes (LBW, stillbirths and neonatal deaths) remain an important public health concern globally. In this study, we observed that the number of ANC visits was significantly associated with LBW, stillbirth and neonatal deaths in a dose-dependent way. In our study, we found that pregnant women who attended less (<8) ANC visits or had no ANC visits had a higher chance of having LBW, stillbirths and early neonatal deaths. A study from SA reported that 33% of perinatal mortality that occurred at birth was due to late or no initiation of ANC booking [9]. Other epidemiological reports identified similar associations of negative outcomes such as preterm births with poor ANC uptake from other parts of the globe [11]- [13].

We argue for the importance of continuous surveillance and response, together with the use of available data to continuously monitor changes and trends to guide decision making on the prioritization of the most appropriate and cost-effective interventions. ANC provides monitoring and regular follow-up of maternal and fetal health during pregnancy. ANC is the care provided by skilled healthcare professionals to women and unborn fetus throughout their pregnancy. It includes risk identification and screening, prevention and management of pregnancy-related or concurrent diseases, and health education and promotion [3]. WHO recommends that ANC should be initiated within the first trimester of gestation, and optimally eight visits during the pregnancy [3]. In this study, we achieved only 25% with 8 or more ANC visits. We further emphasize that the national drive that aspires to achieve a high number of ANC visits and ensure universal coverage of the ANC package for all pregnant women in SA would facilitate the reduction of negative pregnancy outcomes at the community and population level. This finding is relevant from the public health point of view in SA and most low-income settings and countries.

The study has limitations such as maternal and neonatal deaths excluded from those that occurred at hospitals after referrals from this facility during delivery and at post-partum period. Important sociodemographic and reproductive health factors were not available to analyze, and adjust for potential confounding effects. Hence, the study findings should be interpreted cautiously due to the inherent bias related to the retrospective nature of this study. Besides, the probability of ANC uptake directly depends on the duration of gestation before the occurrence of outcomes. Although the study has included several important variables in the analyses, the observed results might be influenced by other factors such as smoking, alcohol consumption and infections e. g., malaria.

However, the prevalence of malaria in the eThekwini district of SA is extremely low.

V. Conclusion

We found a low rate of ≥ 8 ANC visits among pregnant women. There was no maternal death. A higher number of ANC visits were positively associated with decreased occurrences of LBW, stillbirths and neonatal deaths. Strengthening the ANC services should be prioritized in areas or countries with high rates of negative pregnancy outcomes to reduce the burden at the population level. We recommend a clinical audit of ANC to identify the quality of care. It is also necessary to educate communities on the importance of ANC, improve ANC services and monitor indicators to track antenatal problems and deal with them timeously and effectively.

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Author's Contribution

AMH has designed and developed the research concept, and protocol submission for ethical approval, involved in the supervision of data collection, statistical analysis and preparation of the final manuscript. SB helped in data collection, drafting and editing of the manuscript. MH for data capture, data coding, data analysis and drafting of the manuscript. GVH has helped to develop the research concept, protocol and revision of the final manuscript. All authors read and approved the final manuscript.

Conflict of Interest

All authors declare no conflict of interest.

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