Effects of mother related factors on perinatal outcomes-a study of mothers seeking antenatal care at public and non-public health facilities in Kisii County, Kenya

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Abstract

The study sought to determine client-level and facility-level factors that affect perinatal outcomes among women attending comparable public (government owned) and non-public health facilities (non-government owned) in *Kisii* County-Kenya in the context of free maternity care. A total of 365 pregnant mothers recruited in 4 health facilities during their ANC visit and followed up to 2 weeks post-delivery but only 287 attended all follow-up visits. Study subjects were recruited proportionate to number of deliveries each of the facilities had conducted in the preceding 6 months. The dependent variable was perinatal outcome; independent variables were demographic and clinical factors. Analysis was done using χ^2, logistic regression, paired t and McNemar's tests. Maternal BMI and a mother's parity were statistically correlated with perinatal outcome (χ^2= 8.900, d.f =3, P=0.031 and (χ^2= 13.232, d.f =4, P=0.039) respectively. Mothers with 1 parity were 4.5 times more likely to have normal perinatal outcomes (OR =4.5, 95% CI 2.25-14.29, P=0.012). There was a significant relationship between a mother's knowledge of pregnancy-related issues and the baby's weight (t=-67.8 d.f. 213 P<0.001). Mothers' knowledge on pregnancy issues and spousal involvement influences perinatal outcomes. Dietary Diversity Score (DDS) of a mother does not have a direct influence on the outcome of a pregnancy. There is need to focus on maternal factors that affect perinatal outcomes besides free maternity care.

Introduction

Through various Maternal and Child Health (MNCH) commitments, WHO member developing countries[1,2] introduced free and universal access to maternity care services in public health facilities to improve perinatal care outcomes. While this is commendable, evidence shows that neonatal health outcomes among other perinatal outcomes are subject to the effectiveness of antenatal care given to mothers.[3]

The Government of Kenya (GOK) introduced Free Maternity Care (FMC) services for Primary Care[4] to address critical barriers to quality Antenatal Care (ANC) and associated perinatal outcomes. It is documented that risks for adverse perinatal outcomes includes maternal age, parity, race, smoking, birthweight and labor complications.[5] However, there is need to understand whether free maternity care contexts have any effect on some of these determinants.

Materials and Methods

A prospective cohort study design where a total of 365 mothers were recruited from 2 public (Oresi and Kenyenya) and 2 non-public (christamarrianne and Tabaka) health facilities based on the volume of deliveries in the preceding 6 months in each of the facilities. Oresi had conducted 789 deliveries in 6 months, Kenyenya 686, Christamarrianne 515 and Tabaka 388 deliveries. Analysis was done using 287 mothers who attended 3 follow-up ANC visits including the follow-up 2 weeks after delivery. A mother's social-demographic data was collected. Variables measured during follow-up were weight gain, mid-upper arm circumference (MUAC), blood pressure (BP) and urinalysis checks. Also tests for human immunodeficiency virus (HIV), hepatitis B-surface antigen (HBsAg), hemoglobin (HB), serum zinc (Zn++) and ferritin (Fe++) were carried out. Analysis for Zn++ and Fe++ was conducted using atomic absorption spectrophometer (AAS) and Mini-Vidas Radioimmunoassay technology[6] respectively. Data was collected using a semi-structured questionnaire and observation check list. An observation checklist used to assess quality of care being given during subsequent ANC visits. Other Variables assessed included mothers' cumulative Dietary Diversity Score (DDS) and indicators suggestive of a mental distress during pregnancy. At delivery, the study subjects were assessed for indications of a normal or abnormal perinatal outcome; uneventful term pregnancy followed with spontaneous vaginal delivery within 18 h from when labor started, without any complications up to 2 weeks post-delivery was regarded as a normal perinatal outcome. The converse was classified as an abnormal perinatal outcome.

Frequency of factors in mothers with normal vs abnormal perinatal outcomes was compared using χ^2 tests. Logistic regression compared odds of having a normal or abnormal perinatal outcome. Paired t-tests and McNemar's tests were used to compare relative means of different factors at different ANC visits for parametric and non-parametric variables respectively. Data were analyzed using IBM SPSS Statistics for Windows, Version 24.0.

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Key words: Perinatal; pregnancy; maternal child health; free maternity care.

Acknowledgments: we would like to thank the study participants for their participation in the study and the staff at the participating health facilities for supporting data collection.

Funding: 90% of the work was self-funded and 10% funded by a Social Innovations Committee (SIC) under Danone ecosystem.

Contributions: MM conceptualized the study design, study implementation, conducted data cleaning, literature review and drafted the manuscript. SK, PW and KN reviewed the analysis and manuscript and provided key technical comments on manuscript revision. AL assisted in data management and manuscript review.

Conflict of interest: the authors declare no conflict of interest.

Conference presentation: June 2017, University of Nairobi, College Of Health Sciences and Population Reference Bureau (PRB), policy communication fellows summer institute in Dar-es-salaam Tanzania.

Received for publication: 27 April 2017.
Revision received: 5 July 2017.
Accepted for publication: 5 July 2017.

Journal of Public Health in Africa 2017; 8:689
doi:10.4081/jphia.2017.689

Results

Out of the 287 mothers who attended the follow-up ANC visits 3 times including the follow-up 2 weeks after delivery-44% (127) drawn from Oresi, 21% (60) Kenyenya, 21% (60) Christamarriane Mission Hospital (CMMH) and 14% (40) from Tabaka Mission Hospital. Table 1 shows abnormal perinatal outcomes by site while overall adverse perinatal outcomes were 11%.

Mothers' demographic factors

The median age of the respondents was 23 years (IQR 21-27.5 years) while the median age at delivery of the 1st baby was 21 (IQR 10-24 years). 39% of all respondents reported being accompanied by their male partners during the 1st visit, 24% were accompanied at the 2nd visit and 28% were accompanied at the 3rd visit.

There existed a statistically significant association (Table 2) between maternal BMI and a mother's parity and the likelihood of a normal or abnormal perinatal outcome. Zero-parity mothers had an 11% higher likelihood of having an abnormal perinatal outcome (OR =0.113, 95% CI 0.080-0.930, p=0.038) while mothers with 1 parity were 4.5 times more likely to have normal perinatal outcomes (OR =4.5, 95% CI 2.25-14.29, P=0.012). Perinatal outcomes of mothers who had had 2 births were not statistically different from those who had had between 3-6 births.

While there was overall significant relationship between *maternal BMI* and perinatal outcome, logistic regression analysis show that in actual sense, when compared to mothers classified as obese, those who were overweight did not register any statistically different perinatal outcomes to individuals who were overweight (Table 3). However, study participants with a normal BMI were 5 times more likely to have a normal perinatal outcome compared to those classified as obese (OR=5.23, 95% CI 1.55-17.50, p=0.008). Mothers who were accompanied by their spouses to the ANC had a 26% higher chance of normal delivery compared to mothers who were unaccompanied for all the 3 ANC visits (OR 0.26 95% CI 0.08-0.792 P=0.02).

Mothers' knowledge of pregnancy-related issues

During the three ANC visits at the study sites, mothers were asked five pregnancy-related questions to assess their knowledge as their pregnancies progressed. The questions were related to the corresponding trimester of their visits to the ANC (Table

Table 1. Distribution of perinatal outcomes by facility (n=287).

Facility name	Perinatal outcome	
	Abnormal (%)	Normal (%)
Oresi	10 (8)	116 (92)
Kenyenya	7 (11)	54 (89)
CMMH	8 (14)	51 (86)
Tabaka	6 (15)	34 (85)

Table 2. Demographic factors and perinatal outcomes (n=287).

Predictor variable	Perinatal outcome (%)		D.F	Chi-Square	P-values (95% CI)
	Abnormal	Normal			
Age of respondents			2	4.81	0.186
<20 years	3*	17			
20-34 years	94	77			
≥35 years	3*	6			
Education level			3	10.123	0.072
Primary	19	19			
Secondary	30	38			
Tertiary	32	29			
University	19	14			
Parity			3	13.232	0.039
0 child	55	45			
1 child	14	30			
2 children	21	15			
3-6 children	10	10			
Marital status			2	4.09	0.129
Single	3*	8			
Married	94	91			
Separated/Divorced	3*	1*			
Expectant mother accompanied			1	0.07	0.792
Yes	61	59			
No	39	41			
Blood pressure					
Normal	68	62	1	1.5	0.472
Abnormal	32	38			
Maternal BMI			3	8.9	0.031
Underweight	0*	2*			
Normal	13	37			
Overweight	53	44			
Obese	33	18			
Planned pregnancy			1	0.621	0.733
Yes	58	56			
No	42	44			
Therapy aid to conceive			1	0.097	0.616
Yes	7	10			
No	93	90			
Ever used family planning			1	0.123	0.94
Yes	55	55			
No	45	45			
Underwent FGM			1	1.288	0.525
Yes	74	81			
No	26	19			

*Cell contains less than 5 observations which was not considered in analysis.

Table 3. Demographic factors and perinatal outcomes-multivariate analysis.

Variable	Levels	OR	95% CI OR		P-value
			Lower	Upper	
Parity	0 child	0.113	0.080	0.930	0.038
	1 child	4.521	2.245	14.289	0.012
	2 children	0.301	0.059	1.544	0.150
	3-6 children	Ref	-	-	-
BMI	Normal	5.227	1.552	17.598	0.008
	Overweight	1.548	0.652	3.674	0.321
	Obese	Ref	-	-	-

Table 4. Client self-care health practices during ANC visits-paired t-tests.

Self-care health practices	1st ANC	2nd ANC	P-value	3rd ANC	P-value
Weight (Mean-SD)	67.1 (12.1)	69(12)	<0.001 (t=9.042, d.f.279)	69.5 (11.6)	P<0.001, t= –4.91, d.f.247
MUAC (Mean-SD)	26.1 (3.2)	26.1 (3.3)	0.779 (t=0.281, d.f.180)	26.0 (3.5)	0.660 (t= –0.441, d.f.228)
Engage in Pica practice (yes)	33%	21%	0.079	14%	0.002
Engage in physical exercise (yes)	98%	99%	0.821	99%	0.999
Special diet (yes)	2%	1%	-	0.3%	-
Drink water daily (yes)	99%	94%	0.118	79%	0.003

4). At trimester one, the mothers were asked questions relating to sexual intercourse, support from male partners and other risks like UTIs. The most correctly answered question by the mothers was that male partners should accompany their spouses to the antenatal clinic (94%) while only 36% of them knew that vomiting during early pregnancy was normal. The average score of the 5 questions at 1st trimester was 73%. In the 2nd trimester, 92% of the respondents correctly answered 3 questions while the least known question was whether eggs and chicken should be avoided during pregnancy (76%). The average score of the 5 questions in the 2nd trimester was 86%. The difference of knowledge scores between the 1st and 2nd trimester showed a significant increase in knowledge (OR=5.2, 95% CI 0.215-0.902, P=0.023). At the 3rd trimester, the question that had the least correct responses concerned whether delivery by caesarean section was better than a normal delivery (62%) while the most known question regarded whether breastfeeding should start immediately after delivery or not-95% of the respondents correctly answering it should. The average score at the 3rd trimester was 81%. To test a mother's overall knowledge of pregnancy-related issues, each of the 5 questions at each trimester were summed to get a possible highest score of 15 correct points. In the current study, a mother who scored 12 or more correct answers was considered to have adequate knowledge on pregnancy. The study results show that 58% of mothers were adequately knowledgeable. Paired t-tests were performed to compare knowledge of pregnancy (overall score of knowledge questions at 1st, 2nd and 3rd ANC visits) and the baby weight at birth-a measure of a perinatal outcome. The results revealed a significant relationship existed between a mother's knowledge of pregnancy-related issues and the baby's weight (t= –67.8 d.f. 213 P<0.001).

Table 5. Expectant mother's illness assessment-comparative analysis.

Illness during pregnancy	1st ANC visit	3rd ANC visit	P-value
HIV (negative), n=287	94%	97%	-
HB (mean-SD)- g/dL	12.32 (1.48)	12.81 (3.62)	0.407 (t= –0.831, d.f.180)
Urinalysis (normal), n=287	75%	81%	0.394
VDRL (negative), n=287	100%	100%	0.999
HBsAg (negative), n=287	100%	100%	0.999
Zn++ levels (mean-SD)- µg/dL	55.4 (43)	51.9 (14.9)	0.402 (t=0.840, d.f. 136)
Blood sugar (mean-SD)-mmol/L	5.40 (0.82)	5.39 (1.07)	0.881 (t=0.150, d.f. 210)
Ferritin levels (mean-SD)-ng/mL	16.97 (2.31)	13.06 (1.15)	0.052 (t=1.974, d.f. 72)

Mothers' self-care health practices during pregnancy

The mean pre-pregnancy weight of the study respondents was 62.7 kg (SD 12.3), mean weight at the 1st ANC visit was 67.1 kg (SD 12.1), mean weight at 2nd ANC visit was 69 kg (SD 12) and at the 3rd ANC visit the mean weight was 69.5 kg (SD 11.6). Paired t-test results show a statistically significant positive weight change between the 1st and 2nd trimesters (P<0.001, t=9.042, d.f. 279). Similarly, significant positive weight gain was recorded between the 2nd and 3rd trimesters (P<0.001, t= –4.91, d.f. 247). At the time of the study, no respondent was smoking or consuming alcohol. The mean birth weight for the newborns was 3.54 kg (SD 2.81) –13% were delivered with low birth weight (<2.7 kg), 80% were born with normal weight (2.7 kg-4.0 kg) while 7% were born with *above normal* weight. 61% of the expectant mothers had normal BP readings [between (90/60-120/80)], 37% had abnormal (high) blood pressure (120/80-140/90) and 2% had abnormal (low) blood pressure (90/60) or less. The mean BMI of respondents was 26.8 (SD 4.5)-34% were categorized as having a normal BMI (18.5-24.9), 2% were underweight (<18.5), 49% were overweight while 19% were classified as obese.

There neither existed a statistically significant relationship between the final overall Dietary Diversity Score (DDS) scores and birth weight nor DDS scores and delivery outcome (P=0.702). Results also showed no relationship between mothers who had normal or abnormal sleep and birth weight or delivery outcome.

The differences in average MUACs using paired t-test statistics showed no significant changes over the 3 trimesters. There was a statistically significant difference between the number of mothers engaged in pica between the 1st and 3rd trimester (χ^2 =10.04, d.f. 1, P=0.002).

At the 1st, 2nd and 3rd ANC visits, the mothers were assessed for some mental health indicators. McNemar's statistics done to test if mothers experienced frequent crying showed a significant reduction between 1st and 2nd ANC visits (P<0.001) but not between the 2nd and 3rd visits. A statistically significant reduction from 24% to 8% (P<0.001) during the 1st and 2nd ANC visits in mothers who had experienced trouble sleeping was also cited but none between the 2nd and 3rd trimester visits.

Mothers' comorbidity indicators during pregnancy

The mothers were also monitored for several illnesses and conditions at the 1st and 3rd trimesters (Table 5). Paired t-test results show that there did not exist any statistically significant change in the mean HB levels of the mothers between the 1st and 3rd ANC visits. Three quarters (75%) of total

respondents recorded normal urinalysis results at the 1st trimester with a statistically insignificant increase to 81% at the 3rd trimester. All the mothers (100%) screened for both syphilis and hepatitis B tested negative at 1st and 3rd ANC visits respectively. Paired t-test statistics showed an insignificant drop in the mean zinc levels at trimester 1 and 3 (55.4 SD 43 to 51.9 SD 14.9) respectively. Similarly, the mean change in random blood sugar levels at 1st and 3rd visits dropped albeit insignificantly (5.40 SD 0.82 to 5.39 SD 1.07). In the 3rd visit 97% of the mothers were HIV seronegative compared to 94% in the 1st visit because some seropositive mothers were lost to follow-up.

Notably, 84% of all the study participants had low zinc levels (normal range 60-90 µg/dL, abnormal range <60 and >90 µg/dL). Out of the 31 mothers who had abnormal perinatal outcomes, 29 of them (94%) had recorded abnormal zinc levels. McNemar's paired tests do not show a statistical significance between zinc levels and final perinatal outcome due less than 5 observations in one cell. Out of the 214 babies whose birth weight was recorded, 21 had abnormal birth weight; 19 out of 21 babies (90%) born with abnormal birth weight belonged to mothers with low zinc levels. The study also found that 24% of the study participants had low ferritin levels while 28% had low HB levels. There existed a statistically significant relationship between ferritin and HB levels (χ^2= 21.1, d.f =4, P=0.005).

There was no correlation between ferritin levels and dietary diversity scores of the expectant mothers and their perinatal outcomes. Similarly, no statistical association was reported between a mother's zinc levels and the dietary diversity scores.

Discussion

The study revealed a cumulative incidence (CI) of 11% for adverse perinatal outcomes in a period of 6 months follow-up, compared to previous findings in Kiambu, Kenya (Ngugi 2010, unpublished data) and in Tanzania,[7] that reported an incidence of 24% and 10.6% respectively. Maternal BMI analysis revealed findings similar to those in a study conducted in India;[8] high maternal BMI is a risk factor for adverse perinatal outcomes such as macrosomic (large babies) which eventually increases the chance of a mother delivering through caesarian section. A further related study[9] conducted in USA and Sweden, demonstrated that excessive weight gain during pregnancy is associated with adverse perinatal outcomes. Although a previous study among Spanish women,[10] and a related study conducted in Istanbul[11] revealed a significant association between advanced age and perinatal outcomes, the current study didn't demonstrate a significant association between age and perinatal outcomes despite majority of the study subjects having a median age 21 years.

Current study findings too concurred with retrospective study findings in Turkey,[12] where parity had a significant association with perinatal outcomes. Nulliparous women aged ≥ 40 years had more pregnancy complications compared to their multiparous counterparts of same age. Similar findings were also reported in a study conducted in Norway.[13] In the current study there was 26% higher chance for a normal pregnancy outcome among women accompanied by male partners during ANC as compared to those without spousal accompaniment. A Previous study on male involvement in ANC done in Kenya, Lang'ata County,[14] established that although men are willing to be involved in ANC, facilities are lacking clear guidelines on how this should be done. A study in urban Nepal,[15] also established that women whose male partners are involved in ANC care end up with better perinatal outcomes compared to those who do not.

The findings on Knowledge about pregnancy issues and associated perinatal outcomes are similar to those in a Nigerian study.[16] Women with knowledge on risks influencing pregnancy outcomes reported better pregnancy outcomes compared to those with limited knowledge. Similar observations were made in a related Northern Nigeria study.[17] Although Pica practice during pregnancy was significantly associated with infections and low hemoglobin in a previous study,[18] the current study didn't establish any significant association. The current study didn't reveal any statistical difference in mean weight of babies born to pregnant women from pica and non-pica groups. Although previous studies,[19] have established an association between mothers with signs of mental illness and associated perinatal outcomes, the current study found no significant association between mothers with signs of mental distress and perinatal outcomes but on average, 10-21% of the study subjects reported a positive sign(s) for mental distress between the 1st and 3rd visits.

In the current study no significant association got established between Cumulative DDS, micronutrient levels and perinatal outcomes. However, in the current study, 90% of babies with abnormal birth weight were born to mothers with low zinc levels. In the study, 74% of the mothers had zinc deficiency, which almost corresponds with related national study findings in Kenya by Kombe *et al.* (unpublished data) that reported a 68% prevalence of zinc deficiency. A similar study in Alabama[20] also did not establish an association between low zinc levels and perinatal outcomes although a South Australian study,[21] found that low zinc levels were associated with post-partum hemorrhage incidences.

Conclusions

Our study concludes that maternal BMI, parity, knowledge of pregnancy related issues and male accompaniment are predictors of perinatal outcomes. Although serum zinc, HB and Zinc levels did not have significant association with perinatal outcomes under free maternity care there is need to focus on personalized health education of mothers with emphasize on nutrition, stress management, male involvement, knowledge on pregnancy danger signs and indications for Caesarean section.

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