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Original article

The Impacts of Time of Birth on Maternal and Perinatal Outcomes in Low-Risk Pregnancy in Khartoum, Sudan: A Cross-Sectional Hospital-Based Study

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Abstract

Background: The literature shows inconsistency about the influencing of time of birth on pregnancy outcomes across countries, no such data exit in Sudan. Thus, the current study aimed to investigate the influence of time and day of birth on maternal and perinatal outcomes among women with low-risk pregnancy in Khartoum, Sudan. ***Methods:*** A cross-sectional study was conducted from July 2021 to August 2022 in Saad Abuelela maternity hospital, Khartoum Sudan. A structured questionnaire was used to collected sociodemographic and obstetrical data. Chi-square test was performed. ***Results:*** A total of 388 pregnant women were recruited from all low-risk women who delivered in the hospitals The mean (standard deviation) age of the women was 28.26(6.9) years and 172 (44.3%) were primiparas. According to type/frequency of complications occurred, those who were shifted to interventional delivery for fetal compromise 162(41.8%) i.e. emergency caesarean delivery 139(35.8%), and instrumental delivery 23 (5.9%); total maternal complications 51(13.1%) including who 3rd or 4th perineal tears were 12(3.1%), who complicated by postpartum hemorrhage were 36(9.3%), who experienced uterine rupture were 3(0.8%); total neonatal complications 175(45.1%) i.e. who had newborn birth injuries were 10(2.6%); who had birth Asphyxia were 62(16.0%) and who had neonatal admission to neonatal intensive care unit (NICU) were 103(26.5%). There was no association between type/frequency of complications and part of the week (working days vs. weekend days) (P value = 0.915), there was a significant statistical association with part of the day (daytime vs. evening and night-time) (P value = 0.005). ***Conclusion:*** Poor maternal and perinatal outcomes among low risk Sudanese pregnant women was found to be associated with time per day regardless of week or weekend day and not day of week. All efforts should be directed to provide appropriate healthcare services for all pregnant women regardless of time, assessing our local healthcare systems (its weakness, strengths, and opportunities) is a good start to improve maternal and perinatal health in Sudan.

Keywords: ***maternal, perinatal, time of birth, weekdays, weekends, caesarean delivery, Sudan.***

Introduction

Aiming to improve the quality of maternity care, recently, more attention has been paid to the role of time of birth [1-3]. Time of birth (weekdays vs. weekends and daytime vs. evening and night-time) is an important predictor of poor pregnancy outcomes across a range of countries [1-3]. These poor pregnancy outcomes ranged from mild morbidity to maternal and perinatal mortality [3-5]. For instance, labor during weekends, and the night shift was associated with significantly elevated risk for cerebral palsy in emergency cesarean delivery [6]. In a low resource settings such as Africa, evening and night-shift were significantly associated with poor maternal and perinatal outcomes including neonatal intensive care unit (NICU), early neonatal death (ENND) and fresh stillbirth [7,8].

The literature shows inconsistency in the influencing of time of birth on pregnancy outcomes, while some studies showed a negative influencing of weekends on pregnancy outcomes including NICU and prolonged maternal length of stay [1,4], others showed no influencing [2,9-11]. On the other hand, several studies showed a negative influencing of evening and night-time on pregnancy outcomes including neonatal infection, ENND, and NICU [2,7,8,12].

Such variations of influencing of time of birth on pregnancy outcomes necessitate a thorough understanding of the local context. In addition, understanding the influence of time of birth on pregnancy outcomes is essential component in any strategy to improving quality of maternity care and as a consequence good pregnancy outcomes for several reasons. Of them, it will help in organizing work during weekend and evening and night-time, especially in resources limited settings such as Africa.

Although, the emerging literature across countries documented variations of the influencing of time of birth on pregnancy outcomes, to the best of the authors' knowledge, no such

study existed in Sudan where high poor maternal and perinatal exist in different regions of Sudan [13,14]. Therefore, the current study aimed to investigate the influence of time and day of birthing on poor maternal and perinatal outcomes among women with low-risk pregnancy in Khartoum, Sudan.

Materials and Methods

Study design and setting

A hospital-based cross-sectional study was conducted from July 2021 to August 2022 in Saad Abuelela maternity hospital in Khartoum, Sudan, The hospital is affiliated to Faculty of Medicine, University of Khartoum. It provides obstetrics and gynecology services. The hospital also includes five units, each unit served by one consultant, one or two specialists and about four to five registrars and five house-officers. The weekend duties are scheduled in a roster way to be divided equally on each of the five units and the duty itself is covered as a complete 24 hours by the same staff members, with doctor/patient ratio of (2-3:5-6).

Study population

The study population included low-risk pregnancy women who came for vaginal delivery at Saad Abuelela maternity hospital and developed one of the unwanted maternal or perinatal outcomes, during the study period. The low-risk pregnancy was defined based on certain criteria according to previous study as follows [15]: no previous diagnosis of essential hypertension, renal disease, collagen-vascular disease, liver disease, cardiovascular disease, placenta previa, multiple gestation, intrauterine growth retardation, smoking, pregnancy-induced hypertension, premature rupture of membranes (PROM), or other previously documented condition that poses a high risk of poor pregnancy outcome.

Inclusion criteria

Any women with a low-risk term pregnant who presented to the labor room of Saad Abuelela maternity hospital for normal vaginal delivery was eligible to participate in the study.

Exclusion criteria

It included the followings; any high-risk patient with chronic disease or gestational associated conditions, or known to be smoker or alcohol consumer, multiple pregnancy, preterm labor or PROM, previous cesarean delivery, intra uterine fetal demise (IUFD), patients admitted for induction of labor due to any other reason, congenital malformation of the baby, any referred case that would carry any added risk factor or hidden pathology, and any patient that refused to participate in the study.

Sample size and sampling technique

The sample size was calculated using the following equation, $n=Z^2Pq/e^2$, n = sample size, Z = Level of Confidence Measure= 1.96, P = Baseline levels of the indicators= 0.5 (to have adequate sample size we assumed 50% of women who delivered on weekends had maternal and/or perinatal complication/s), q = 1-p = 0.5, e = Margin of Error = 0.05.

$n = 0.5^2*0.5*0.5/1.96^2 = n \approx 384$. Finally, 194 case per each hospital with random picking, giving a total sample of 388 cases.

Data Collection

Two female medical officers were trained by the investigators to collect the data. The data were collected via a structured questionnaire. It covered the socio-demographic data of the participants (age in years, residence, and site of delivery) and obstetrical data such as parity, any experiencing poor maternal outcomes (emergency CS, instrumental delivery, incidence of 3rd or 4th perineal tears, postpartum hemorrhage (PPH)) and perinatal outcomes (birth asphyxia, newborn birth injury, neonatal admission to NICU), follow-up status (antenatal booking/ unbooking), at what part of the week admitted/delivered, at what part of the day admitted/delivered and who followed the labor progress. The medical officers collected data during the onset of the acute complication occurrence or soon after, either in the labor ward, operating theatre, post-natal wards, HDU or NICU, based on simple randomization or random picking and sampling of cases, time, day and the outcome.

Statistical analysis

Data were entered and analyzed in the statistical package for the social sciences (SPSS) version 22. Continuous data were evaluated for normality using the Shapiro-Wilk test and revealed normally distributed (maternal age). Normally distributed continuous data were analyzed by t-test, and expressed as a mean (standard deviation, [SD]). Categorical data were analyzed by Chi-square test, and expressed as frequencies (%). Chi-square test was used to find the association between part of the week (weekdays and weekends) and part of the day (early morning, daytime, evening and late night) as independent variables independently, and poor maternal and perinatal outcomes as dependent variable. A P-value of <0.05 was considered statistically significant.

Ethical approval

The ethical approval was obtained from research ethical committee of Sudan Medical Specialization Board. In addition, permission was obtained from the administration of the two hospitals. The informed consents were obtained from all participants after well informed about the study's objectives, methods, and study ethics such as the confidentiality, and the right to withdraw at any time of the study.

Results

From the total included 388 low risk pregnant were enrolled. Each of the women had developed one of the complications at a time. The mean (SD) was 28.26 (6.9) years, ranged from 15 to 42 years. Of the total, 388 women, 249 (64.2%) and 139 (35.8%) were from urban and rural areas, respectively.

From the total 388 women, primigravida were 172 (44.3%), para I-III were 149(38.4%), para IV-PV were 67(17.3%). Booked women were 239 (61.6%), un-booked were 118 (30.4%), referred, who referred themselves on their demand rather than a medical or surgical issues, were 31 (8.0%).

According to day of week, women who presented during working days were 218 (56.2%) and those who presented during weekend days were 170 (43.8%). According to part of day, women who delivered during early morning were 74 (19.1%), during daytime were 98(25.3%), during evening time were 134(34.5%) and during night were 82(21.1%).

According to healthcare professionals who followed labor progress, house officer 17(4.4%), registrar trainee 303(78.1%), and specialist 68 (17.5%).

According to type/frequency of complications occurred, those who were shifted to interventional delivery for fetal compromise 162(41.8%) i.e. emergency caesarean delivery 139(35.8%), and instrumental delivery 23(5.9%); total maternal complications 51(13.1%) including who 3rdor 4thperineal tears were 12(3.1%), who complicated by PPH were 36(9.3%), who experienced uterine rupture were 3(0.8%); total neonatal complications 175(45.1%) i.e. who had newborn birth injuries were 10(2.6%); who had birth Asphyxia were 62(16.0%) and who had neonatal admission to NICU were 103(26.5%).

While there was no association between type/frequency of complications and part of the week (working days vs. weekend days) (P value = 0.915), there was a significant statistical association with part of the day (daytime vs. evening and night-time) (P value = 0.005), Table 2.

Table 1: Frequency and proportions of the characteristics of women in Khartoum, Sudan (number =388)

Variable		Frequency	Proportion
Residence	Rural	139	35.8
	Urban	249	64.2
Antenatal follow up status	Booked	239	61.6
	Un-booked	118	30.4
	Referral	31	8.0
Parity	Primigravida	172	44.3
	1 to 3	149	38.4
	>4	67	17.3
Complications	Interventional delivery	162	41.8
	Maternal complications	51	13.1
	Neonatal complications	175	45.1
Time of complication per day of week	Working days	218	56.2
	Weekend days	170	43.8
Time of complication per day time	Early morning	74	19.1
	Daytime	98()	25.3
	Evening time	134	34.5
	Night	82	21.1
Healthcare professional following the labor progress	House officer	17	4.4
	Registrar trainee	303	78.1
	Specialist	68	17.5

Table 2: Comparing maternal and perinatal outcomes according to the delivery time

Variable	Total (388)	Part of the week			Part of the day				
		Weekdays (218)	Weekends (170)	P value	Early morning (74)	Daytime (98)	Evening time (134)	Night time (82)	P value
	Frequency (Proportion)				Frequency (Proportion)				
Interventional delivery (caesarean section and instrumental delivery)	162(41.8)	89(40.8)	73(42.9)	0.915	27(36.5)	52(53.1)	58(43.3)	25(30.5)	0.005
Maternal complications	51(13.1)	29(13.3)	22(12.9)		15(20.3)	5(5.1)	14(10.4)	17(20.7)	
Neonatal complications	175(45.1)	100(45.9)	75(44.1)		32(43.2)	41(41.8)	62(46.3)	40(48.8)	

Discussion

To the best of the authors' knowledge, this is the first study of its kind that explored the influencing of time of birth on pregnancy outcomes in Sudan. The main findings of the current study was poor maternal and perinatal outcomes among low risk Sudanese pregnant women associated with time per day regardless of week or weekend day and not day of week.

The current study showed association between time per day and maternal and perinatal complications. Likewise, several studies form both high low- and high-resource settings showed similar results [2,7,8,12]. A previous cross-sectional study included 4,556 women in Nigeria showed neonatal complications (NICU admission and ENND) were commoner during evening hours [8]. In Tanzania, a cross-sectional study included 2,636 deliveries showed off-hours deliveries, particularly during the night shift, were significantly associated with higher proportions of perinatal complications (low Apgar score, ENND, and fresh stillbirth) [7]. A retrospective cross-sectional study recruited 421 pregnant women in Turkey revealed newborns delivered during evening and night-time were at higher risk of infection and NICU admission [12]. A retrospective cohort study of 449,714 infants (born at >28 completed weeks) in the Netherlands concluded birth in the evening and night-time, were at an increased risk of perinatal complications (perinatal death) [2].

The association between evening and night-time with poor maternal and perinatal outcomes could be explained by many reasons, of them, shortages of healthcare professionals (healthcare professional patient ratio), and poor healthcare professionals performance during evening and night-time. Healthcare professionals who are involved in night-shift work at risk of poor sleep quality and as a consequence poor performance [16]. Gerein et al. addressed the shortages of maternal healthcare professionals in Sub-Saharan Africa, and its impacts on reaching the Millennium Development Goal on maternal health [17].

In the current study day of week (weekdays vs. weekends) was not associated with poor maternal and perinatal outcomes. This is similar to previous studies which showed no influencing of weekends on maternal and perinatal outcomes [2,9-11].

A recent retrospective cohort study included 42,870 deliveries revealed weekends were not more risky for women and

their children compared to weekdays as women who delivered on weekdays are more likely to deliver via cesarean delivery than those who delivered on weekends [11]. A retrospective cohort study using data on all non-elective deliveries (n=27,466) in United Kingdom concluded weekend delivery has no effect on maternal or neonatal morbidity [9].

A case series of 1,615,041 live births (weight >500 g) in California between 1995-1997, the United State concluded after adjusting for birth weight, the increased odds of death for infants born on the weekend were no longer significant [10]. Likewise, in the Netherlands while evening and night-time associated with perinatal complications, weekend deliveries were not associated with an increased risk compared with weekday deliveries [2].

In contrast, other studies showed a negative influencing of weekends on pregnancy outcomes [1,4]. A population-based retrospective cohort study included discharge data for California births between 2009 and 2010 (N=724,967) showed weekend delivery was a consistent risk factor for perinatal complications [1].

An observational study examined outcomes for maternal and neonatal records (1,332,835 deliveries and 1,349,599 births between 1 April 2010 and 31 March 2012) revealed poor maternal and perinatal outcomes for women admitted, and babies born, at weekends, in particular, the perinatal mortality rate was 7.3 per 1000 babies delivered at weekends, 0.9 per 1000 higher than for weekdays [4].

The contradictory between studies can be justified by the variations of the provided quality of care to pregnant women and their newborns during the weekdays and weekends. Furthermore, it can be justified by the variability in how well hospitals deal with surges in volume.

It is worth emphasizing that all efforts should be directed to provide appropriate healthcare services for all pregnant women regardless of time of birth. Assessing our local healthcare systems (its weakness, strengths, and opportunities) is a good start to improve maternal and perinatal health in Sudan.

Although the present study adds to the existing knowledge that aimed to improving quality of maternity care in Sudan [18], it has some limitations that must be mentioned. Due to the nature of the present study as a cross-sectional study, it is difficult to investigate long term impacts on maternal and perinatal outcomes. Thus, a longitudinal study should generate more information regarding the impacts of time of birth on maternal and perinatal outcomes. Although, our study provided information from Khartoum, central Sudan, it does not provide nationally representative data on influencing time of birth on maternal and perinatal outcomes among pregnant women in other regions of Sudan; hence, it studied one geographical region only (central Sudan). Moreover, our study did not collect as much information about ethnicity as compared to other studies [1,4], given that Khartoum State is a multi-ethnic community [19]. Furthermore, information about shortage of workforce in the hospitals and their competencies, such information are crucial and can be obtained in future research. Therefore, there is need for a larger prospective multi-centre study with longer follow-up period and overcoming of these limitations.

Conclusion

Poor maternal and perinatal outcomes among low risk Sudanese pregnant women was found to be associated with time per day regardless of week or weekend day and not day of week. All efforts should be directed to provide appropriate healthcare services for all pregnant women regardless of time, assessing our local healthcare systems (its weakness, strengths, and opportunities) is a good start to improve maternal and perinatal health in Sudan.

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Author contributions

The author conducted all the work.

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Availability of data and materials

Data are available from the corresponding author upon reasonable request.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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