

A Hospital-Based Cross-Sectional Study Assessing the Relation between Time of Birth and Perinatal Outcome

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Abstract

Objectives: Investigating the relation between perinatal outcomes and hospital working shifts. **Methods:** We conducted a cross-sectional study at Philippe Maguilen Senghor health center (PMSHC) in Dakar, Senegal from January, 1st 2011 to December, 31th 2018. The study population was comprised of all mothers who had delivered at PMSHC and their newborns after completing 22 weeks of gestation. Time of delivery was divided into three periods of working hours: morning shift (deliveries occurred between 7 am and 4:59 pm); evening shift from 5 pm to 10:59 pm and night shift from 11 pm to 6:59 am. Maternal outcomes were assessed by mode of delivery, episiotomy and perineal injuries. The Apgar scoring system was used to assess newborns at first minute after they were born. Other adverse perinatal outcomes included fresh stillbirth, neonatal referral and early neonatal death. Data were analyzed using Statistical Package for Social Science software (SPSS 24, Mac version). **Results:** A total of 48,270 mothers and their newborns met eligibility criteria. Caesarean section deliveries were less likely to occur during evening (OR 0.84, 95% CI; 0.79 - 0.89, p = 0.001) and night shifts (OR 0.45, CI; 0.47 - 0.53, p = 0.001). Evening shift deliveries had 1.1 the odds of poor perinatal outcome (Apgar score < 7) compared to morning shift deliveries (OR 1.1, 95% CI; 1.02 - 1.18, p = 0.012). No significant difference was found in the odds of neonate referrals and deaths across the three shifts. Night shift deliveries had 1.1 the odds of perineal injuries compared to morning shift deliveries (OR 1.11, 95% CI; 1.04 - 1.18, p = 0.001, for episiotomy and OR, 1.14; 95% CI, 1.04 - 1.26, p = 0.008, for perineal tears). **Conclusion:** Off-hours deliveries, partic-

ularly during the night shift, were significantly associated with higher proportions of perineal injuries compared to morning shift. However, no significant difference was found in the odds of neonate referrals and deaths across the three shifts. Our findings suggest to set up a Neonatology unit at the CSPMS as well as a perinatal network across the country.

Keywords

Perinatal Outcome, Time of Birth, Low-Resource Setting

1. Introduction

Atypical shifts, and particularly night shifts, can be a risk factor for workers. Indeed, the organism is subjected to a so-called circadian rhythm, programmed by an internal clock, and which acts on many physiological activities including food intake, hormonal secretions and the alternation of wakefulness and sleep. In Obstetrics, working on evenings and at night is unavoidable. In addition to these atypical working shifts, stress of working in labor wards increases the risk of error. Previous studies investigating the relation between time of delivery and early intrapartum and neonatal deaths have shown poor outcomes. These complications include fetal injury, perinatal death, and early neonatal death. Other studies have linked intrapartum deaths to admission to the neonatal intensive care unit [1] [2]. In addition, other studies observed a greater risk for deliveries occurring on off-working hours (*i.e.* evening and night shifts and weekends) compared to working hours [1]-[8].

Very little was found in the literature on the relation between time of delivery and perinatal outcome in developing countries. On this background we compared the prevalence of adverse perinatal outcome across the three hospital working shifts, including the morning shift (7 am - 5 pm), evening shift (5 pm - 11 pm) and night shift (11 pm-7 am).

2. Methods

2.1. Design, Population and Setting

We conducted a cross-sectional study at Philippe Maguilen Senghor health center (PMSHC) in Dakar, Senegal from January, 1st 2011 to December, 31st 2018. PMSHC is a level 2 health center. It does not have the performance of a hospital but surgical procedures are practiced there. Teams of residents in Obstetrics, midwives and nurses provide continuous Obstetric Emergency and Neonatal Care (EmONC). The on-call duties are carried under the supervision of an obstetrician. In 2018, the number of deliveries encountered in our department was 8172 comprising 1500 cesarean sections.

The study population was comprised of all mothers who had delivered at PMSHC and their newborns after completing 22 weeks of gestation.

The dataset included information on maternal characteristics (age, parity, medical history), obstetric and perinatal outcomes.

Furthermore, time of delivery was divided into three periods of working hours: morning shift (deliveries occurred between 7 am and 4:59 pm); evening shift from 5 pm to 10:59 pm and night shift from 11pm to 6:59 am.

2.2. Outcomes

Maternal outcomes were assessed by mode of delivery, episiotomy and perineal injuries.

The Apgar scoring system was used to assess newborns at first minute after they were born. Apgar score was further categorized as less than 7 and greater than or equals to 7. Other adverse perinatal outcomes included fresh stillbirth (birth of a dead fetus without postmortem changes based on physical appearance, including blistered or peeled-off skin), neonatal referral and early neonatal death that is death of a newborn within 7 days post-delivery.

2.3. Data Analysis

Data were extracted from E-Perinatal, our electronic medical recording system, and then analyzed using Statistical Package for Social Science software (SPSS 24, Mac version).

Mean, median and standard deviation were considered to describe continuous variables while frequencies were reported for categorical and nominal variables.

Odds ratios and their 95% confidence interval were computed to see the strength of association between perinatal outcomes and working shifts.

Multiple logistic regression analysis was used to measure independent associations between selected predictors of adverse outcomes in relation to shifts.

3. Results

A total of 48,270 mothers and their newborns met eligibility criteria. Mothers' characteristics are shown in **Table 1**. The average age of patients was 27 years.

When comparing the distribution of mode of deliveries (**Table 1**), near one fourth (23.6%) of the studied group delivered by caesarean section. Caesarean section deliveries were less likely to occur during evening (OR 0.84, 95% CI; 0.79 - 0.89, $p = 0.001$) and night shifts (OR 0.45, CI; 0.47 - 0.53, $p = 0.001$) as shown in **Table 2**.

Evening shift deliveries had 1.1 the odds of poor perinatal outcome (Apgar score < 7) compared to morning shift deliveries (OR 1.1, 95% CI; 1.02 - 1.18, $p = 0.012$) while night deliveries were found to be a protective factor. No significant difference was found in the odds of neonate referrals and deaths across the three shifts.

Night shift deliveries had 1.1 the odds of perineal injuries compared to morning shift deliveries (OR 1.11, 95% CI; 1.04 - 1.18, $p = 0.001$, for episiotomy and OR, 1.14; 95% CI, 1.04 - 1.26, $p = 0.008$, for perineal tears).

Table 1. Patients' characteristics.

	Morning shift	Evening shift	Night shift	Total
Age				
≥35 years	2351 15.6%	1264 14.1%	1845 14.8%	5460 15.0%
<35 years	12,700 84.4%	7673 85.9%	10,638 85.2%	31,011 85.0%
Parity				
Multiparous	9277 61.6%	5314 59.5%	7574 60.7%	22,165 60.8%
Nulliparous	5774 38.4%	3623 40.5%	4909 39.3%	14,306 39.2%
Admission				
Direct admission	12,340 82.0%	7162 80.1%	10,239 82.0%	29,741 81.5%
Referral	2711 18.0%	1775 19.9%	2244 18.0%	6730 18.5%
Type of pregnancy				
Multiple	523 3.5%	278 3.1%	329 2.6%	1130 3.1%
Singleton	14,528 96.5%	8659 96.9%	12,154 97.4%	35,341 96.9%
Presentation				
Vertex	14,139 93.9%	8441 94.5%	11,880 95.2%	34,460 94.5%
Malpresentation	912 6.1%	496 5.5%	603 4.8%	2011 5.5%
Infant condition				
Alive	14,545 96.7%	8582 96.1%	12,050 96.6%	35,177 96.4%
Fresh stillborn	261 1.7%	164 1.8%	193 1.5%	618 1.7%
Macerated still-birth	245 1.6%	191 2.1%	240 1.9%	676 1.9%

Table 2. Perinatal outcome of current delivery according to three shifts of 24 h.

Outcome	Time of delivery							
	Morning shift		Evening shift			Night shift		
	N	OR	N	OR	P	N	OR	P
Cesarean section	4326 28.7	1	2263 25.3	0.84 0.79 - 0.89	0.001	2092 16.8	0.45 0.47 - 0.53	0.001
Apgar score < 7	2076 13.8	1	1338 15	1.1 1.02 - 1.18	0.012	1682 13.5	0.97 0.9 - 1.04	0.44
Neonate referral	67 0.4	1	58 0.6	1.46 1.03 - 2.08	0.035	46 0.4	0.83 0.57 - 1.21	0.32
Neonatal death	57 0.4	1	26 0.3	0.77 0.48 - 1.22	0.24	51 0.4	1.08 0.74 - 1.58	0.70
Episiotomy	2718 18.1	1	1633 18.3	1.01 0.95 - 1.09	0.68	2452 19.6	1.11 1.04 - 1.18	0.001
Perineal injury	845 5.6	1	541 6.1	1.08 0.96 - 1.21	0.16	796 6.4	1.14 1.04 - 1.26	0.008

OR: Odds ratio, CI: Confidence Interval.

4. Discussion

Evening and night shifts were associated with adverse maternal outcomes including episiotomy and perineal injuries when compared with the morning shift. However, poor perinatal outcome was not significantly associated with time of delivery.

Our results are in line with previous studies [9] although refuted by others from resource limited-settings [10].

- **Relation between caesarean section and time of delivery**

Rates of caesarean deliveries during night and evening shifts found in this study were lower to that of morning shift; prophylactic caesareans excluded. Our findings are in line with Mgaya results who did not find any significant difference between the distribution of caesarean deliveries in regard with the time of delivery (48% at night, 47% in the evening and 46% during the day) [10]. We did not expect such findings as one of our hypotheses was that the relatively limited human and physical resources during the evening and the shifts compared to the morning could elevate the rate of caesarean section as well as poor outcomes during off-hours. One of the explanations might be that the morning shift is spread over 9 hours while those for evening and night are spread over 6 and 8 hours respectively.

- **Perinatal outcome**

Neonate referrals and deaths of newborns were more likely to occur during the morning shift than in the evening. PMSHC has only one neonatal pediatrician for 7,000 to 8,000 deliveries per year. To mitigate this lack of human resources, our department had engaged in task-shifting with the training of nurses who provide Emergency neonatal care. Even if the task shifting is to be welcomed, these nurses are very quickly limited to recognizing and dealing adequately with situations such as neonatal distress or the recognition of certain emergency situations which require immediate referral. One might argue that a department with only one pediatrician should not perform the delivery of certain women and/or newborns at high risk. Here is the place to issue a distress call regarding the management of risky pregnancies in Dakar. Only three maternity units are equipped to properly take care of newborns in Dakar. One does not have maternity ward and is limited by the number of beds/incubators. Access to the two other departments is limited by the daily cost of hospitalization, which varies between FCFA 35,000 (\$65) and FCFA 50,000 (\$90). In addition, no guideline clearly provides information for organizing efficiently perinatal healthcare in Senegal.

It seems clear that at least some of the adverse outcomes that occur in obstetrics are preventable and that the root causes of these preventable events such as neonatal death, although multiple, often involve a teamwork [11]. In France, for instance, maternity units provide obstetric and neonatal care according to their quality components. Three maternity levels can be described. Extreme premature and the small for gestational age newborns benefit from a birth in a type III

maternity in order to decrease the risks of mortality and morbidity.

For such an organization to properly work in our country, patients should have a valid health insurance available in all maternity units where they are likely to be staying. It is common some patients suffering from severe preeclampsia forgo perinatal care (maternal transfer) for financial reasons.

Whereas in developed countries rationing is performed by using various strategies such as denial, selection, delay, deterrence, deflection or dilution, rationing in our limited-resource settings is mainly by ability to pay at the point of delivery. Direct payment by patient, the worst health financing system, must be addressed in order to provide patients and their newborns with adequate healthcare.

The need for multidisciplinary neonatal care in the event of fetal malformation (congenital diaphragmatic hernia, omphalocele, transposition of great arteries) also justify an antenatal orientation towards appropriate maternity.

Poor prenatal outcomes in our study is partly explained by this situation which need to be improved by upgrading out department in order to provide patients with pediatricians available 24 hours/day.

- **Strengths and weaknesses of the study**

This study reports data from patients whose outcome is already known. The recording is retrospective and continuous and does not only involve the parameters studied in the study but also a large number of socio-demographic, obstetrical and neonatal parameters. For these reasons and given the sample size, we can consider the data from this study to be reliable. However, there may still be biases because of the type of study.

5. Conclusions

Off-hours deliveries, particularly during the night shift, were significantly associated with higher proportions of perineal injuries compared to morning shift. However, no significant difference was found in the odds of neonate referrals and deaths across the three shifts.

Our findings suggest to set up a Neonatology unit at the CSPMS and redeploy a part of the Neonatology staff (dependent on the Chair of Pediatrics) to the CSPMS in view of the number of deliveries recorded by the structure and finally work to set up a perinatal network.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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