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Cesarean Section: Incidence, Causes, Associated Factors and Outcomes: A National Prospective Study from Jordan

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Abstract

Objectives: To determine the rate of cesarean section (CS) in Jordan and its causes, associated factors, and neonatal outcomes.

Methods: The study is part of a comprehensive national study of perinatal mortality which was conducted between 2011 and 2012 in Jordan. The study was concurrent prospective in design. A sample of 18 hospitals with maternity departments was selected. All women ≥ 20 weeks of gestation admitted for delivery in any of the 18 selected hospitals were enrolled in the study. Data were collected by interviews and abstraction of data from medical records.

Results: The overall rate of CS was 29.1% (13.2% as emergency CS and 15.9% as planned CS). Health sector, income of >350, <12 years of education, increased gestational age at delivery, primiparity, previous CS, male gender, overweight, obesity, pre-gestational and gestational diabetes, non-cephalic presentation, multiple pregnancy, preeclampsia, anemia, smoking, history of neonatal death/stillbirth, and previous hospitalization during current pregnancy were all associated with increased odds of CS in the multivariate analysis. The most frequent reason for planned CS was scarred uterus (59.4%) and for emergency CS was prolonged fetal distress (30.0%). The neonatal death rate was significantly higher (p=0.000) for planned CS (2.1%) and emergency CS (2.5%) as compared to vaginal delivery (0.9%).

Conclusion: The rate of CS in Jordan is high (29.1%). CS is associated with increased risk of neonatal death. As most CSs are currently based on physician's judgment, it may be extremely useful to develop and implement national guidelines for performing CS. Obstetricians' adherence to these guidelines should be strictly monitored.

Keywords: Cesarean section; Jordan; Neonatal; Mortality

Introduction

WHO) that the rate of cesarean section (CS) should not exceed 10% to 15% in any country [1]. In recent years, the rate of caesarean deliveries increased dramatically worldwide and many countries had exceeded the WHO recommended rate [2].

Many factors have been identified to be associated with CS across the world such as premature rupture of the amniotic membrane, cephalo-pelvic disproportion, fetal distress, multiple pregnancy, breech presentation, place of birth (private or public hospital), maternal preference, birth weight, parity, maternal height and antenatal care use [3-10]. The main indications for cesarean delivery are previous cesarean delivery, breech presentation, and fetal distress [11]. Although CS is a safe operation, when it is performed without medical need it puts mothers and their babies at risk of short- and long-term health problems. Most complications of CS, however, come from the cause which leads to CS. Factors that make some women more likely to have complications include: obesity, large infant size, prolonged labor, multiple pregnancy, and premature labor. In the absence of a clear medical indication, the excess risk associated with the operation itself must be considered. Short- and long-term maternal and infant problems associated with elective caesarean section are higher than those associated with vaginal birth [12-14].

In Jordan, a study conducted between 2002 and 2012 showed that the rate of CS increased from 18.2% in 2002 to 30.3% in 2012 with the most common reason for CS being "absence of a clear indication" [3]. In Jordan, as in many Arab countries, there is a preference for relatively large families. As CS limits the number of children a mother can give birth to, it becomes of paramount importance to perform such operation only when clear medical indications exist.

This study aimed to determine the rate of CS in Jordan and its causes, associated factors, and neonatal outcomes, using a huge sample size representing the different regions and health sectors in Jordan. This information is necessary for alerting health authorities and provides a baseline for future policies and strategies against this rapidly increasing problem.

Methods

Study design

The study is a part of a comprehensive national study of perinatal mortality which was conducted between 2011 and 2012 in Jordan. Details of the study design were described elsewhere [15]. In brief, a sample of 18 hospitals with maternity departments was selected to represent the three regions of Jordan (South, Middle, and North) and the different medical sectors (Ministry of Health, Royal Medical Services, Private sector, and University Hospitals). Sample selection was guided by the Technical Committee of the study that included experts from the Ministry of Health, General Department of Statistics, and a number of international agencies (UNICEF, WHO, and Health System Strengthening (HSS)). All deliveries with a gestational age ≥ 20 week that took place in any of the 18 hospitals during the study period (March 2011- April 2012) were invited to participate in the study. Consenting women were interviewed by the trained midwives in these hospitals using a structured questionnaire prepared for the purpose of this study. Additional information was also collected based on the physical examination by the midwife and the obstetrician at admission and at discharge. Data on the newborn were also collected by the pediatric nurses and the neonatologists in these hospitals. The study instrument included the interview questionnaire as well as data sheets to be completed by the midwife and the pediatric nurse under the supervision of the obstetrician and the neonatologist who were required to sign all data forms. The status of new borns (dead or alive) was ascertained 28 days after delivery. Midwives were required to call mothers by telephone for this purpose. If the new born has died in hospital before 28 days the cause of death was ascertained by the neonatologist. If death occurred at home, a verbal autopsy was performed to find out the cause of death. A total of 21,928 women delivering in these hospitals during the study period were included in the study with a response rate of about 99%. The study was approved by the Jordanian Institutional Review Board (IRB). An informed consent was obtained from all participating women. Every effort was made to protect the confidentiality and the identity of participants.

Data Collection

Extensive data were collected on each woman included in the study and her new born through interview and by abstraction of relevant data from medical records. Data obtained included socio-demographic variables, obstetric history, antenatal care, mode of delivery, complications of delivery, new born status (dead or alive), Apgar score, birth weight, birth injuries and complication etc. Data on cesarean delivery including cause, whether the CS was planned or emergency, and the occurrence of any complications were ascertained by the obstetrician. The study team consisted of 126 persons including hospital obstetricians and neonatologists, midwives, and pediatric nurses. A 2-day workshop was conducted to train all the study team and a 1-day pilot study was carried out in each of the participating hospitals.

Variable definitions

Stillbirth was defined as any fetus born without a heartbeat, breathing, and pulsation of umbilical cord or definite movement of voluntary muscles. The stillbirth rate was calculated as the number of stillbirths per 1,000 live births plus fetal deaths (stillbirths). Neonatal death was defined as a death of a live born infant within the first 28 days of life. Neonatal mortality rate (NNMR) was calculated as the number of deaths during the first 28 completed days of life per 1,000 live births. A baby who was born with a weight of less than 2,500 g was considered low birth weight baby. A premature baby was defined as a baby who was born before 37 completed weeks of pregnancy. The baby is scored for Apgar score at 1 and 5 minutes after birth. Apgar score was classified as: A score of 8-10 is considered normal, 4-7 is intermediate, 0-3 is poor and the infant requires immediate resuscitation.

Preeclampsia was defined according to International Society for the Study of Hypertension in Pregnancy (ISSHP). Obesity was defined according to body mass index (BMI) and it was calculated as pre-pregnancy women weight in Kg divided by height in meters square. A woman with BMI >30 kg/m2 was considered as obese.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS IBM 20). The rate of CS, overall and by relevant variables were calculated. The differences in CS rates according to studied variables were tested using Chi-square test. Multivariate analysis using logistic regression was conducted to determine the factors associated with CS. The outcomes of cesarean delivery for the baby were obtained and compared with the rest of the deliveries in bivariate and multivariate models. The frequency of the different causes for CS was also obtained. CS were classified into emergency and planned and the frequency of each, overall and by relevant variables were obtained. A pvalue of less than 0.05 was considered statistically significant.

Results

Participants' characteristics

This study included a total of 21,928 women. Their age ranged from 14 to 55 with a mean (SD) of 27.9 (6.0). Of all women, 28.1% gave birth in private hospitals, 48.8% in public hospitals, 19.2% in military hospitals, and 3.9% in teaching hospitals. About 2.9% of women gave birth to two or more

fetuses. Only 13.1% of women were employed, 28.5% were overweight, 9.6% were obese, 5.0% had high blood pressure, 1.3% had preeclampsia, 1.2% had gestational diabetes, and 0.6% had pre-gestational diabetes. About 8.2% of women had a history of preterm or low birth weight delivery, and 5.3% had a history of neonatal death or stillbirth.

Rate of cesarean section

The overall rate of CS was 29.1% (13.2% for emergency CS and 15.9% for planned CS). **Table 1** shows the mode of delivery according to socio-demographic characteristics. CS was significantly higher among women who were older than 35 years and in highly educated women (44.4%, 35.7%, respectively). The rate of CS was significantly lower in women delivering in south of Jordan (23.6%), compared to that in the middle and the north (31.7%, 30.8%, respectively). Planning of CS was significantly more common among Christian Jordanian women than that among Muslims (33.3% vs.16.6%) and among women who smoke compared to that among non-smokers (20.7%, 16.5%, respectively). CS rate in Jordanian and non-Jordanian women was nearly the same (30.5% vs. 30.6%). CS rate was significantly higher among women who delivered in teaching and private hospitals (42.5%, 37.6%, respectively) compared to women who delivered in military and public hospitals (31.3%, 25.2%, respectively) **(Figure 1).** CS rate was significantly higher in employed women (39.6%), compared to the rate of CS in housewives (29.1%). It was obvious that the CS rate is higher when fathers are educated >14 years compared with poor educated fathers (36.2% vs. 26.6%).

Table 1 Mode of delivery of Jordanian women according to socio-demographic, characteristics, 2011-2012.

Variable	Mode of delivery			Total	P-value
	Planned N (%)	Emergency N (%)	Vaginal N (%)		
Age (year)					
<20	69 (5.4)	171 (13.3)	1046 (81.3)	1286	0.000
20-35	2619 (15.6)	2310 (13.7)	11890 (70.7)	16819	
>35	764 (29.4)	388 (15.0)	1443 (55.6)	2595	
Occupation					
Housewife	2848 (15.9)	2374 (13.2)	12718 (70.9)	17940	0.000
Employee	593 (21.9)	480 (17.7)	1636 (60.4)	2709	
Region					
North	1166 (16.2)	1056 (14.6)	4997 (69.2)	7219	0.000
Middle	1971 (17.5)	1607 (14.3)	7695 (68.3)	11273	
South	319 (14.4)	206 (9.3)	1696 (76.4)	2221	
Religion					
Muslim	3439 (16.6)	2862 (13.9)	14361 (69.5)	20662	0.000
Christian	17 (33.3)	7 (13.7)	27 (52.9)	51	
Sector					
Private	1292 (22.2)	901 (15.5)	3633 (62.4)	5826	0.000
Public	1395 (13.8)	1147 (11.4)	7560 (74.8)	10102	
Military	565 (14.2)	681 (17.1)	2730 (68.7)	3976	
Teaching	204 (25.2)	140 (17.3)	465 (57.5)	809	
Nationality					
Jordanian	3221 (16.15)	2728 (14.0)	13536 (69.5)	19485	0.007
Others	235 (19.1)	141 (11.5)	852 (69.4)	1228	
Mother's education					
<12	964 (14.2)	820 (12.1)	4988 (73.7)	772	0.000
12-14	1679 (17.8)	1249 (13.2)	6521 (69.0)	9449	

>14	796 (18.0)	783 (17.7)	2842 (64.3)	4421	
Father's education					
<12	1055 (14.4)	893 (12.2)	5389 (73.4)	7337	0.000
12-14	1611 (17.1)	1330 (14.1)	6494 (68.8)	9435	
>14	762 (19.9)	625 (16.3)	2446 (63.8)	3833	
Smoking					
Yes	142 (20.7)	104 (15.1)	441 (64.2)	687	00.00
No	3312 (16.5)	2764 (13.8)	13945 (69.7)	20021	

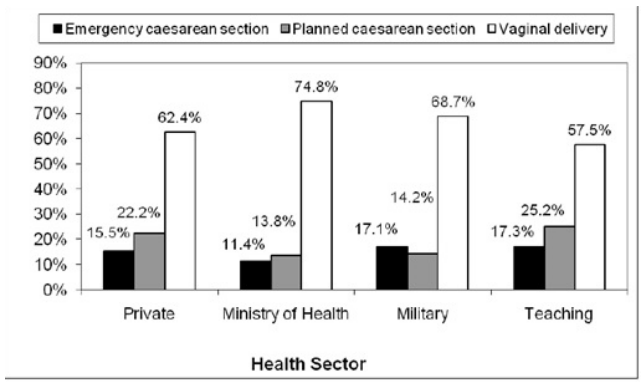

Figure 1 The rate of caesarean section according to health sector, Jordan 2011-2012.

Table 2 shows the mode of delivery in Jordanian women according to clinical, anthropometric, obstetric and other relevant characteristics. Women who had diabetes mellitus, preeclampsia, fever, anemia, hypertension, overweight and obesity and past history of stillbirth were more likely to deliver via CS. Breech or presentations other than cephalic, history of CS in previous deliveries, past history of early onset of labor, being transferred from other hospitals, and being hospitalized during the index pregnancy were significantly associated with higher rate of CS delivery. Breech presentation and other non-cephalic presentations (such as transverse and cord presentation) were associated with a very high rate of CS (91.2% and 98.2%, respectively) as compared to cephalic presentation (26.4%). Mothers who had past history of CS had a high rate of CS (74.9%) as compared to mothers who didn't have a past history of CS (20.3%). Mothers who were transferred from other hospitals had a very high rate of CS (61.2%) as compared to mothers who didn't have a history of transfer from other hospitals (29.9%). Mothers with history of hospitalization during the current pregnancy had a very high rate of CS (47.2%) as compared to mothers without history of hospitalization (29.4%).

Table 2 Mode of delivery of Jordanian women according to clinical, anthropometric, and obstetric characteristics, 2011-2012.

Variable	Mode of delivery			Total N (%)	P-value
	Planned N (%)	Emergency N (%)	Vaginal N (%)		
Preeclampsia					
Yes	72 (25.9)	101 (36.3)	105 (37.8)	278	0.000
No	3382 (16.6)	2767 (13.5)	14281 (69.9)	20430	
Diabetes mellitus					
No Diabetes	3286 (16.2)	2800 (13.8)	14249 (70.1)	20335	0.000
Gestational diabetes	105 (41.3)	48 (18.9)	101 (39.8)	254	
Pre-gestational diabetes	63 (52.9)	20 (16.8)	36 (30.3)	119	
Anemia					
Yes	729 (20.4)	494 (13.8)	2350 (65.8)	3573	0.000
No	2725 (15.9)	2374 (13.9)	12036 (70.2)	17135	
High blood pressure					

Yes	254 (24.6)	281 (27.2)	499 (48.3)	1034	0.000
No	3200 (16.3)	2587 (13.1)	13887 (70.6)	19674	
Body mass index					
Normal	1524 (13.2)	1488 (12.9)	8528 (73.9)	11540	0.000
Overweight	1071 (18.1)	837 (14.2)	4001 (67.7)	5909	
Obesity	527 (26.5)	326 (16.4)	1137 (57.1)	1990	
History of stillbirth					
No	3121 (15.9)	2727 (13.9)	13743 (70.1)	19591	0.000
Yes	332 (30.2)	137 (12.5)	630 (57.3)	1099	
Antenatal visits					
None	22 (9.6)	28 (12.3)	178 (78.1)	228	0.000
1-8	860 (14.1)	719 (11.8)	4520 (74.1)	609	
>8	2530 (17.8)	2093 (14.7)	9610 (67.5)	14233	
Birth weight					
≥ 2500	3033 (16.1)	2462 (13.0)	13378 (70.9)	18873	0.000
<2500	422 (23.0)	405 (22.1)	1004 (54.8)	1831	
Apgar score					
Poor (0-3)	27 (22.7)	48 (40.3)	44 (37.0)	119	0.000
Intermediate (4-7)	1747 (19.7)	1610 (18.1)	5515 (62.2)	8872	
Normal (8-10)	1573 (14.1)	1132 (10.2)	8420 (75.7)	11125	
Fetus presentation					
Cephalic	2770 (14.3)	2357 (12.1)	14302 (73.6)	19429	0.000
Breech	465 (52.4)	345 (38.9)	78 (8.8)	888	
Other	209 (55.0)	164 (43.2)	7 (1.8)	380	
Gestational age					
≤ 31	64 (19.6)	81 (24.8)	181 (55.5)	326	0.000
32-36	345 (27.9)	268 (21.6)	625 (50.5)	1238	
≥ 37	3046 (15.9)	2518 (13.2)	13576 (70.9)	19140	
History of C-section					
Yes	2304 (59.6)	592 (15.3)	968 (25.1)	3864	0.000
No	1149 (6.8)	2272 (13.5)	13405 (79.7)	16826	
History of stillbirth					
Yes	332 (30.2)	137 (12.5)	630 (57.3)	1099	0.000
No	3121 (15.9)	2727 (13.9)	13743 (70.1)	19591	
History of early onset of laboratory					
Spontaneous	538 (3.8)	1465 (10.3)	12164 (85.9)	14167	0.000
Induced	130 (4.1)	910 (28.5)	2155 (67.4)	3195	
Planned C-section	2730 (87.6)	382 (12.3)	3 (0.1)	3115	

Multivariate analysis of factors associated with CS

Multivariate analysis **(Table 3)** showed many factors to be associated with CS. Health sector was significantly associated with the rate of CS. Compared to those who gave birth in private hospitals, women who gave birth in Ministry of Health hospitals (OR=0.4) and Military hospitals (OR=0.6) were less likely to deliver via CS. The rate of CS increased significantly with increased age. The odds of delivering via CS among women aged ≥ 30 years was 3.7 times that odds among women aged <20 years. Income of >350 vs. ≤ 350 JD, <12 years of education, increased gestational age at delivery, primiparity, previous CS (OR=23.8), baby's male gender, overweight, obesity, pre-gestational and gestational diabetes, non-cephalic presentation, multiple pregnancy, preeclampsia, anemia, smoking, history of neonatal death/stillbirth, and hospitalization during current delivery were all associated with increased odds of CS in the multivariate analysis.

Table 3 Multivariate analysis of factors associated with cesarean section. Jordan 2011- 2012.

Variable	OR	95% confidence interval		P-value
Sector				
Private	1	-	-	-
Public	0.4	0.4	0.5	0.000
Military	0.6	0.6	0.7	0.000
Teaching	0.8	0.7	1.0	0.057
Age (year)				
14-19	1	-	-	-
20-24	1.6	1.3	1.9	0.000
25-29	2.4	2.0	3.0	0.000
≥ 30	3.7	3.0	4.7	0.000
Gestational age				
<28	1	-	-	-
28-32	7.1	3.5	14.4	0.000
32-37	7.3	3.9	13.5	0.000
>37	4.6	2.5	8.3	0.000
Number of deliveries				
1	1.8	1.5	2.1	0.000
2	1.1	1.0	1.3	0.148
≥ 3	1	-	-	-
Inter-delivery interval				
First delivery	7.5	6.3	8.8	0.000
<2 years	0.9	0.8	1.0	0.046
>2 years	1	-	-	-
Diabetes mellitus				
No Diabetes	1	-	-	-
Gestational diabetes	3.1	2.2	4.4	0.000
Pre-gestational diabetes	2.8	1.7	4.9	0.000
Presentation at delivery				
Cephalic	1	-	-	-
Breech	52.0	39.7	68.2	0.000

Other	342.2	138.6	844.7	0.000
Body mass index				
Normal	1	-	-	-
Overweight	1.4	1.3	1.6	0.000
Obesity	1.9	1.6	2.2	0.000
Mother's education				
<12 years	1.2	1.0	1.4	0.016
12-14	1.1	1.0	1.2	0.159
>14	1	-	-	-
Region				
North	1	-	-	-
Middle	0.8	0.7	0.9	0.000
South	0.6	0.5	0.7	0.000
Baby's gender (Male vs. Female)	1.1	1.1	1.2	0.001
Number of fetuses (Multiple vs. Single)	3.3	2.5	4.2	0.000
Preeclampsia	3.2	2.3	4.5	0.000
Anemia	1.3	1.1	1.4	0.000
Income (JD) (>350 vs. ≤ 350)	1.2	1.1	1.3	0.000
Smoking	1.4	1.2	1.8	0.002
History of low delivery/preterm delivery	0.8	0.7	0.9	0.003
History of neonatal death/stillbirth	1.3	1.0	1.5	0.018
Previous cesarean section	23.8	21.3	26.5	0.000
Hospitalization during current delivery	1.5	1.3	1.8	0.000

Reasons for planned and emergency CS

Table 4 shows the various reasons for planned CS according to health sector. The most frequent reason was scarred uterus (59.4%). The second most common reason was abnormal presentation like breech or presentations other than cephalic (7.9%). Other relatively common reasons included multiple pregnancy (6.8%), medical problems (6.2%), and mothers' desire for CS (5.6%). The distribution of these reasons varied significantly according to sector. **Table 5** shows the various reasons for emergency CS according to health sector. The most frequent reason was prolonged fetal distress (30.0%) followed by obstructed labor (24%), abnormal presentation (15.6%), and eclampsia or sudden severe high blood pressure or seizure (8.1%). The distribution of these reasons varied according to health sector.

Table 4 Reported reasons for planned cesarean section in Jordanian women according to sector, 2011-2012.

Variables	Total N (%)	Sector			
		Private N (%)	Public N (%)	Military N (%)	Teaching N (%)
Scarred uterus	2056 (59.5)	770 (59.6)	937 (67.2)	254 (45.0)	95 (46.6)
Abnormal presentation	274 (7.9)	81 (6.3)	87 (6.2)	94 (16.6)	12 (5.9)
Multiple fetuses	234 (6.8)	58 (4.5)	74 (5.3)	77 (13.6)	25 (12.3)
Special medical Condition	215 (6.2)	110 (8.5)	77 (5.5)	21 (3.7)	7 (3.4)
Mother's desire	192 (5.6)	80 (6.2)	35 (2.5)	38 (6.7)	39 (19.1)

Placenta previa or Placenta malposition	76 (2.2)	30 (2.3)	24 (1.7)	14 (2.5)	8 (3.9)
Large fetus	69 (2.0)	26 (2.0)	20 (1.4)	22 (3.9)	1 (0.5)
Precious fetus	65 (1.9)	26 (2.0)	21 (1.5)	16 (2.8)	2 (1.0)
Post date	46 (1.3)	16 (1.2)	27 (1.9)	3 (0.5)	0 (0.0)
Old primi	25 (0.7)	2 (0.2)	22 (1.6)	1 (0.2)	0 (0.0)
Cephalo-pelvic disproportion	25 (0.7)	10 (0.8)	13 (0.9)	0 (0.0)	2 (1.0)
Bad obstetric history	17 (0.5)	11 (0.9)	3 (0.2)	2 (0.4)	1 (0.5)
Oligohydramnios	17 (0.5)	8 (0.6)	5 (0.4)	4 (0.7)	0 (0.0)
Infection of vaginal tract	11 (0.3)	3 (0.2)	7 (0.5)	1 (0.2)	0 (0.0)
Anterior posterior vaginal repair	11 (0.3)	5 (0.4)	3 (0.2)	1 (0.2)	2 (1.0)
Congenital anomaly	10 (0.3)	3 (0.2)	4 (0.3)	1 (0.2)	2 (1.0)
IUGR	10 (0.3)	5 (0.4)	0 (0.0)	5 (0.9)	0 (0.0)
Others	103 (3.0)	48 (3.7)	36 (2.6)	11 (1.9)	8 (3.9)
Total	3456 (100.0)	3456 (100)	1395 (100)	565 (100.0)	204 (100.0)

Table 5 Reasons for emergency cesarean section in Jordanian women according to sector, 2011-2012.

Variables	**Total N (%)**	**Sector**			
		Private N (%)	**Public N (%)**	**Military N (%)**	**Teaching N (%)**
Prolonged fetal distress	862 (30.0)	246 (27.3)	230 (20.1)	335 (49.2)	51 (36.4)
Obstructed labor	700 (24.4)	274 (30.4)	231 (20.1)	149 (21.9)	46 (32.9)
Abnormal presentation	447 (15.6)	87 (9.7)	253 (22.1)	87 (12.8)	20 (14.3)
Eclampsia or sudden sever high blood pressure or seizure	231 (8.1)	52 (5.8)	142 (12.4)	33 (4.8)	4 (2.9)
Heavy persistent vaginal bleeding	113 (3.9)	30 (3.3)	68 (5.9)	15 (2.2)	0 (0.0)
Cephalopelvic disproportion	76 (2.6)	17 (1.9)	47 (4.1)	11 (1.6)	1 (0.7)
Mother exhaustion	60 (2.1)	17 (1.9)	40 (3.5)	3 (0.4)	0 (0.0)
Cord prolapse	44 (1.5)	10 (1.1)	14 (1.2)	15 (2.2)	5 (3.6)
Premature labor pain	35 (1.2)	22 (2.4)	9 (0.8)	4 (0.6)	0 (0.0)
Failed vacuum or forceps delivery	31 (1.1)	8 (0.9)	9 (0.8)	10 (1.5)	4 (2.9)
High floating fetal head	29 (1.0)	26 (2.9)	3 (0.3)	0 (0.0)	0 (0.0)
Abnormal intra uterine fetal heart nonstress test	15 (0.5)	11 (1.2)	2 (0.2)	1 (0.1)	1 (0.7)
Failed labor induction	10 (0.3)	0 (0.0)	9 (0.8)	0 (0.0)	1 (0.7)
Rupture of uterus	4 (0.1)	4 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)
Other mother reasons	148 (5.2)	63 (7.0)	70 (6.1)	13 (1.9)	2 (1.4)
Other fetal reasons	64 (2.2)	34 (3.8)	20 (1.7)	5 (0.7)	5 (3.6)
Total	2869 (100.0)	901 (100.0)	1147 (100.)	681 (100.0)	140 (100.0)

Association between CS and neonatal mortality

The neonatal death rate was significantly higher (p=0.000) for planned CS (2.1%) and emergency CS (2.5%) as compared to vaginal delivery (0.9%). After adjusting for important predictors of neonatal mortality including gestational age, history of neonatal death/stillbirth, birth weight, and baby's gender **(Table 6),** mode of delivery was significantly associated with neonatal mortality. The rate of neonatal mortality for babies born via CS was 1.3 times higher than for babies born by normal delivery.

Table 6 Neonatal mortality by mode of delivery and other relevant variables using multivariate logistic regression, Jordan 2011-2012.

Variable	OR	95% confidence interval		P-value
Mode of delivery (cesarean section vs. vaginal)	1.3	1.0	1.7	0.041
Gestational age (<37 vs. ≥ 37)	7.2	5.1	10.2	0.000
History of neonatal death/ stillbirth (yes vs. no)	1.8	1.2	2.7	0.004
Birthweight (<2500 vs. ≥ 2500)	11.3	7.8	16.2	0.000
Baby's gender (Male vs. Female)	1.4	1.1	1.8	0.011

Discussion

This study demonstrated a markedly high rate of CS of 29.1% in Jordan. The observed rate of CS in this study was higher than the previously reported rate of 27.7% from the higher population Council maternal morbidity study in Jordan (2007-2008) [16], and the rate of 18.5% from the 2007 Jordan Population and Family Health Survey [17]. The figure becomes more striking when compared to the previously reported data from seven military hospitals across the country revealing a rate of only 8% for the period 1990-1992 which increased to 10.9% for the period 1999-2001 [18]. In fact, an increasing trend in cesarean deliveries has been observed almost everywhere during the past few decades. In Egypt, CS rate increased from 4.6% to 10% between 1992 and 2000 [19]. Ba'aqeel [20] reported that over the period between 1997 and 2006, CS delivery rate increased from 10.6% to 19.1% in Saudi Arabia.

The high rate of CS has well surpassed the recommendations of the WHO health experts who considered the ideal rate for CS to be between 10% and 15% [1]. The problem is serious in Jordan and most Arab countries which prefer relatively larger families. Limitation of the number of children a woman can give birth to due to repeated CS may expose her to family problems such as divorce or polygamy. It has been claimed that many reasons may have led to this high rate of CS. One reason is performing unnecessary CSs for training purposes by some residents. This is supported by the finding that the highest CS rate was in teaching hospitals (42.5%). However, the kind of women delivering in teaching hospitals may differ from women delivering in other hospitals which may explain such higher CS rates in teaching hospitals. Another reason for the high rate is financial since hospitals charge more money for CS than normal vaginal delivery. This is supported by a higher rate of CS in the private sector (37.6%) as compared to the public sector (25.2%). Similar findings were also reported from a national study of 57 out of 230 hospitals in Syria, where the CS rate was 12.7% in public hospitals compared to 22.9% in the private sector [21,22].

The study showed that increased age was significantly associated with CS. CS rate was higher among women who were older than 35 years (44.4%). Peipert and Bracken [23] observed that women whose age is >30 years had a 70% increase in risk for caesarean delivery compared with women <30. A lot of other studies showed that increased maternal age is associated with an increase in CS rate [24]. There is no satisfactory explanation for this linear association between age and CS rate. However, pelvic rigidity and over care for premium babies in this group might be behind this increase. Moreover, we found a significantly higher CS rate among highly educated women. Highly educated women tend to be older than low educated women, because usually they get married and pregnant at an older age. However, controlling for age in the present study did not remove the effect of education.

This study showed that women with preeclampsia had a significantly increased CS rate. Preeclampsia is known to be associated with intrauterine growth restriction, fetal distress and prematurity [25]. Because of that a lot of mothers with preeclampsia plan to deliver via CS. Similar findings were reported from another study [26]. Moreover, our study showed that CS rate was significantly higher in both mothers with gestational diabetes (60.2%) or pre-gestational diabetes (69.7%). It has been recently observed that women with diabetes have "impaired uterine contractility". Obesity in the present study was associated with a higher rate of CS (42.9%). Similar findings were reported by others [27,28] and a linear relationship between BMI and cesarean delivery has been reported [29].

One study showed that obese women were 6 times more likely to have CS due to cephalo-pelvic disproportion or failure to progress than non-obese women [30]. In the present study, 45.3% of all cesareans were performed on emergency basis and 55.7% were planned. This finding is not consistent with other studies which showed that emergency CS far exceeds planned CS. [31,32]. Consistent with another study [33], the most common reasons for emergency CS in the current study were prolonged fetal distress, obstructed labor, and abnormal presentations such as breech or transverse presentations. The most frequent reason cited for planned CS was scarred uterus, which mostly reflects previous CS. Among the proposed factors contributing to the increase in cesarean is patient desire. Mother desire in the current study was one of the main reasons for planned CS accounting for 5.6% of all planned CS. The reason provided by participating women for preference of CS was simply to avoid pain of vaginal delivery. On the other hand, in a previous study of maternal morbidity in Jordan

(2007-2008), mother desire accounted for less than 1% of cesarean deliveries [17].

The increase in cesarean delivery rates overtime has not been associated with improvements in neonatal outcomes [34]. In the present study, the neonatal death rate was significantly higher in planned CS and emergency CS, as compared to vaginal delivery. The current study and many other international studies support an increase in neonatal death in women undergoing CS. A possible explanation is that mothers undergoing CS, and newborns that are products of CS, may have serious medical conditions like preeclampsia, diabetes mellitus, scarred uterus, fetal distress, congenital anomalies, heart diseases, etc. In other words, it is very difficult to attribute the excess in neonatal mortality to CS as it may be resulting from the causes for which CS was performed. The present study is a national study utilizing a huge sample size (about 15% of all deliveries in a year) representing the different regions and health sectors in Jordan. The study assessed comprehensively all women during their admission and followed them prospectively to ascertain the status of their newborns and determine the causes of any deaths within 28 days after birth. The main limitation of this study is that the reasons for CS were provided by the obstetrician who is likely to provide legitimate reasons for performing CS. Provided reasons may not be the actual reasons; it is unlikely that an obstetrician would formally confess that he performed CS for illegitimate reasons such as training of residents, convenient timing, or financial reasons. Therefore, the reasons stated in this study are those reported by the obstetricians; studying the actual reasons needs a different design.

Conclusion

Future research is needed to explore the nonclinical causes of CS like attitudes, behaviors, and skills of obstetricians as well as the social, economic, and legal environment in the country. We need also to understand the preferences of women in this regard. As much of the offered causes for cesarean delivery in this study are to an extent subjective and dependent on the judgment of the physician, research may be directed to uncover the true causes for this alarming health problem. To maintain an acceptable caesarean section rate, a multidisciplinary quality assurance program should be established in all facilities in which delivery occurs. As most CSs are currently based on physician's judgment, it may be extremely useful to develop and strictly implement national guidelines for performing CSs.

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