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Determining Factors of Cesarean Delivery Trends in Developing Countries: Lessons from Point G National Hospital (Bamako – Mali)

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1. Introduction

Pregnancy and delivery have been and continue to be a high risk endeavour for women [Rivière, 1959]. This assertion explains the continuous efforts of healthcare workers to maintain pregnancy and delivery in a normal course.

One of the obstetric interventions introduced to address this issue is the cesarean – delivery. Cesarean delivery is defined as the birth of a fetus through incisions in the abdominal wall (laparotomy) and the uterine wall (hysterotomy) [Cunningham, 2001]. Historically, cesarean delivery was associated with a high complication rate, sometimes causing maternal death. In the era of modern medicine, however, cesarean section has become safe and is widely endorsed throughout the world as a strategy to improve pregnancy outcomes [Weil & Fernandez, 1999].

In the past decades, cesarean rates in high income countries have increased considerably, leading some experts to question the benefit of these elective procedures on maternal and neonatal outcome [Howell et al, 2009; Malvasi et al, 2009; Ba'aqeel, 2009; Jain, 2009; Karlström et al, 2010; Klemeti et al, 2010; Bogg, 2010]. Critics of the trend toward unindicated cesarean delivery have coined these procedures "unneCesareans" [Althabe et al, 2004; Cohain, 2009]. Policies targeted to reverse this trend have been generally unsuccessful [Choudhury et al, 2009].

This epidemic increase is even encountered in some developing countries [Belizán et al 1999; Khawaja et al., 2009; Naidoo & Moodley, 2009; Betran et al, 2007; Villar et al., 2006; Onsrud & Onsrud, 1996; Barros et al, 1991; Faundes & Cecatti, 1991]. Reasons behind the high cesarean delivery rates in some developing countries are generally unclear [Wylie & Mirza, 2008]. Doing more to gain more mainly in private practice [Naido & Moodley, 2009; Wylie & Mirza, 2008]; presumption that CD protects against urinary incontinence, pelvic prolapse, and sexual dissatisfaction ; auspicious date of birth; beliefs that babies delivered surgically are smarter…. [Wylie & Mirza, 2008] are some of the unjustified reasons reported.

Most developing countries, however, report cesarean delivery rates well below the acceptable minimum standard of 5% outlined by the WHO. Poor healthcare access, underdeveloped healthcare infrastructure, geographical inaccessibility, cultural mistrust, poverty, and paucity of human health resources are barriers to providing cesarean deliveries to all women who need them [Dumont et al., 2001; De Brouwere et al, 2002; Ronsmans et al, 2002; Kwawukume, 2001]. Large ecological studies in West Africa emphasized this gap by demonstrating increased maternal mortality in settings with a lower percentage of births supervised by a skilled attendant, fewer deliveries performed in-hospital, or a smaller proportion of deliveries performed by cesarean section. Increased access to these services correlated with lower maternal mortality rate [Ronsmans et al, 2003].

Mali is the 3rd poorest nation in the world, with an estimated maternal mortality ratio between 464 and 830 deaths per 100,000 live births [Chou et al, 2010; Samaké et al, 2007]. In 1990, the Mali Ministry of Health developed a healthcare initiative focusing on the maternal and child health. Among the key elements of the Malian healthcare system, is the clear distinction between the three levels of care provision: primary (community health centres), secondary (district referral health centres) and tertiary care (hospitals). Pregnant women are initially supposed to

book at the community health centres (which is the entry point of the healthcare system) with a primary care midwife or obstetric nurse for care provision during pregnancy, birth and the puerperium. These community health centres have the pivotal role of patients selection based on risk assessment. One important innovation of this new policy was the establishment of a referral system for perinatal complications in 1994. To ensure that referral takes place in an optimal fashion, guidelines for consultation and collaboration between community health centres, district referral health centres and hospital have been formulated in the Perinatality Module and in the Standard, Options and Procedures for Reproductive Health Services Manual. In these documents, all professional groups involved in maternity care agreed on the indications for consultation and referral according to the level of care. This program augmented the healthcare system's capacity to manage obstetric emergencies by upgrading referral centres' technical trays including staff training, surgical theatre rehabilitation, creation community health centres in previously inaccessible areas, organisation of transport between the community centres and referral centres, and communities' mobilisation to own the system. The main obstetric emergency encountered was cephalopelvic disproportion and its complications. Cesarean delivery was the main obstetric procedure used to deal with these complications. Lowering of financial barriers to increase access to this major obstetric intervention was one of the strategies of the organisation of the referral system in Mali.

To date, there have not been any in-depth evaluations of cesarean delivery in Mali since the inception of this program. Poor data capture of most population health indicators have called into question the reliability of cesarean delivery reports for other developing countries [Stanton et al, 2005; Holtz and Stanton, 2007]. In this context, large hospital databases of good quality provide a bird's eye view of the national health system and trends in healthcare delivery over time.

This paper aims to assess the trends of cesarean delivery at the Point G national hospital in Bamako, Mali over a period of 2 decades. We explore the impact of sociodemographic,

obstetric, and systemic determinants on cesarean delivery rates. Results are discussed in relation to current medical literature available for developing countries and lessons for improvement of current health systems are highlighted.

2. Study settings and design

2.1 Organisation of delivery care at Point G teaching hospital

Point G National Hospital is a tertiary care referral center in Bamako, Mali affiliated with the Faculty of Medicine, Pharmacy, and Odonto-stomatology at the University of Bamako. This hospital provides emergency obstetric services for women referred from other health centers, as well as prenatal care and delivery services for women from urban and rural areas surrounding Bamako. The catchments population in Bamako grew rapidly from 658,275 in 1987 to 1,016,296 in 1998.

The cesarean delivery rate was 6.5% in Bamako versus 1.6% for the national level [Samaké et al, 2007]. Many patients referred to Point G hospital reside in rural areas surrounding Bamako. Thus, rates of early access to care and facility-based delivery among patients at Point G hospital may be lower than those found among residents of Bamako.

The services available at Point G hospital have changed over time, dividing the hospital's history into distinct periods. Among the major events that influenced obstetric admission at Point G hospital, is the National Perinatality Program implemented in 1994, which included organization of a referral system between primary health structures and district referral centers. Access to cesarean delivery was the cornerstone of this organization which improved transport and designed schemes to lower its cost for women in needs. This referral system has been shown to increase access to emergency obstetric care and decrease maternal mortality in rural Mali [Fournier et al, 2009], though its impact on maternal deaths at an urban tertiary care center is unknown. Between 1998 and 2000, an audit of near-miss events was undertaken to improve delivery services. In 2002 the Government of Mali reorganized the healthcare system, integrating the staff of Point G National Hospital with those at Bamako's Gabriel Touré Teaching Hospital.

The obstetrics and gynecology service of Point G teaching hospital was equipped with 1 labor ward containing 3 delivery tables, 30 beds, and a single operating room for scheduled surgeries as well as emergent surgeries from 1985 to 1994. The hospital has an adult intensive care unit (ICU), but no neonatal ICU, and administers a limited blood transfusion service. At Point G National Hospital the general surgery and urology services also provided care during delivery mainly to those women requiring cesarean delivery.

2.2 Obstetric database

A complete database of all obstetric admissions focusing on characteristics of delivered women, mode of delivery, cesarean indications, and maternal, fetal and immediate neonatal outcome was built to include all deliveries recorded at Point G National Hospital between January 1, 1985 and December 31, 2003 (17 721 patients) [Teguete et al, 2010a]. All data were double-entered in Epi6.fr to insure accuracy. Data were collected from these complete obstetric files, as well as hospital birth registries, registries of on-call midwives, surgical

reports, admissions records for the intensive care service, records from the internal medicine and urology services, and hospital death records.

2.3 Analysis

We report trends in cesarean delivery rates at Point G National Hospital in Bamako, Mali from 1985 to 2003. Annual cesarean deliveries rates were calculated and grouped by historic time intervals to elucidate changes in cesarean utilization over time. These intervals represent 5 distinct periods in the hospital's history: 1985 to 1990 before the department of obstetrics and gynecology was established by the first Malian professor in this field ; 1991 to 1995 encompassing the introduction of the National Perinatality ProgramProgram; 1996 to 1997 when the service of obstetrics and gynecology functioned at partial capacity due to hospital renovation; 1998 to 2001 immediately after renovation; and 2002 to 2003 when the major obstetric team moved from Point G to Gabriel Touré Teaching Hospital, another teaching hospital in Bamako.

We first computed cesarean delivery rates during the five time periods according to different categories to observe general trends. Cesarean delivery rates were calculated as the percentage of pregnant women delivered after surgical opening of the abdomen. Crude and adjusted odds ratios (OR) were obtained by logistic regression and subsequently transformed into relative risks (because rates of cesarean delivery were more than 10%) by the equation:

$$RR = \frac{OR}{(1 - p_0) + p_0 * OR} \text{ [Zhang \& Yu, 1998].} \quad (1)$$

Characteristics considered to be of relevance for cesarean delivery were: maternal age, marital status, ethnic group, parity, hypertension or diabetes in pregnancy, gestational age, number of fetus (single vs. multiple gestations), cesarean delivery indications and referral status.

We then described the contribution of different indications to overall cesarean delivery rates following the rules of the Baltimore group on cesarean indications reporting for developing countries [Stanton et al, 2008]. Interactions of these indications with maternal characteristics have been reported. The next step looked for our practice concerning specific obstetric group. This step focused on the study of cesarean delivery in ten obstetric groups. The definition of these groups appears in table 3. Based on the review of the relevant literature about this topic [Stavrou et al., 2011; Costa et al, 2010; Brennan et al, 2009; McCarthy et al, 2007; Robson, 2001], we focused on the correlation between trends of overall cesarean delivery rates and that of the cesarean delivery rates in term single cephalic nulliparas (TSCN). The term single cephalic nulliparas gathered groups 1 and 2 during the 19 year period. Pearson's correlation coefficient was used to estimate the relationship between overall CS rates and TSCN cesarean delivery rates. Independent Student *t* test was used to compare mean overall CS rates. The coefficient of variation (CV) was calculated as the standard deviation (SD)/mean x 100. The relevant cesarean indications characterising this specific composite group were identified. Finally, we identified individual factors influencing the cesarean delivery rates in our hospital by multilogistic regression using sequential adjustments.

The final section of the analysis dealt with cesarean morbidity and mortality. We considered maternal as well as fetal and neonatal complications. For maternal complications, we estimated rates of intraoperative complications as well as of post-cesarean complications. We defined intraoperative complications as laceration of the uterus (uterine rupture included), cervix, bladder, vagina or bowel, intraoperative blood loss of ≥1000 ml, blood transfusion, and hysterectomy. Post-cesarean complications included post-cesarean infection, hemorrhage, deep venous thrombosis and puerperal psychosis. Regarding post-cesarean infection, we specifically determined surgical infection rate as well as serious infectious morbidity rate. For surgical site infection we adopted the CDC definition as stated by Horan et al. [Horan et al, 1999]. Serious infectious morbidity was defined as bacteremia, septic shock, septic thrombophlebitis, necrotizing fasciitis; peritonitis, or death attributed to infection. Risk factors for intra-operative complications and post-cesarean infection have been studied. We first computed crude odds ratios followed by adjusted odds ratios. We adjusted each factor for potential confounders in a multivariate logistic regression model. The final step in this analysis of maternal complications studied the trends of cesarean related maternal death risk and relationship between cesarean delivery and maternal mortality in a multivariate analysis of primary predictors including antenatal screening, referral status, maternal age, parity and route of delivery. In this analysis adjusted odds ratio have been produced for cesarean delivery. Regarding fetal and neonatal prognosis, we estimated trends of stillbirth rates and neonatal death rates. These indicators were studied by comparing cesarean to vaginal delivery. Stillbirth was defined as Apgar score = 0 immediately after delivery in a live-born-infant. Neonatal deaths are those occurring during the first 28 days following delivery. However, neonatal death rates presented are underestimated since our observation period was limited to the duration of hospitalization at birth; the maximum length of follow up of the neonates was 13 days. Neonates discharged healthy were assumed to have survived to 28 days. Nonetheless, the rates presented give an idea of the size of this important issue.

All calculations were performed using SPSS version 11.0 (SPSS Inc, Chicago, IL). $P<0.05$ was considered statistically significant. The database used for this analysis was reviewed and approved by the ethics committee of the Faculty of Medicine, Pharmacy, and Dentistry at the University of Bamako, Mali.

3. Findings

3.1 Characteristics of deliveries in our teaching hospital

During a nineteen year period from 1985-2003, 17,721 women delivered at Point G Teaching Hospital, 20.2% of whom traveled from other regions in southern Mali. The proportion of women residing outside of Bamako increased significantly from 13.3% of deliveries between 1985 and 1990 to 23.6% during the period 1998 – 2003 ($p <0.001$).Among the women delivering at Point G, 29.9% were referred from outside health institutions. Patients referred for an obstetric emergency represented 18.1% of women delivering while non-emergency referrals constituted 11.8%. Emergency admission rates varied from a minimum of 7.6% of deliveries in 1986 to a maximum of 25.1%of deliveries in 2000. Patients with non-emergent referrals accounted for a minimum of 7.1% of deliveries in 1990 and a maximum of 21% of deliveries in 1998.

Years	Total deliveries	Number of cesarean delivery	Cesarean delivery rates	Odds ratio	Relative risk	P value	% cesarean in TSCN	Contribution Of TSCN to Total deliveries
1985	1056	132	12.5%	Reference			10.3%	19.3%
1986	948	132	13.9%	1.13	1.1	>0,05	14.7%	20.8%
1987	977	173	17.7%	1.51	1.4	<0,001	19.2%	19.8%
1988	1028	172	16.7%	1.41	1.3	<0,05	13.8%	18.3%
1989	1079	220	20.4%	1.79	1.6	<0,001	19.1%	21.7%
1990	982	204	20.8%	1.84	1.7	<0,001	26.3%	20.9%
1991	1066	279	26.2%	2.48	2.1	<0,001	27.5%	23.9%
1992	1114	317	28.5%	2.78	2.3	<0,001	25.9%	19.3%
1993	1169	340	29.1%	2.87	2.3	<0,001	28.6%	21.8%
1994	1041	298	28.6%	2.81	2.3	<0,001	33.7%	19.2%
1995	1098	343	31.2%	3.18	2.5	<0,001	30.4%	21.8%
1996	747	209	28.0%	2.72	2.2	<0,001	28.3%	24.6%
1997	298	110	36.9%	4.10	3.0	<0,001	26.7%	20.0%
1998	944	305	32.3%	3.34	2.6	<0,001	33.0%	24.4%
1999	847	297	35.1%	3.78	2.8	<0,001	40.7%	22.2%
2000	894	262	29.3%	2.90	2.3	<0,001	32.6%	20.6%
2001	1070	352	32.9%	3.43	2.6	<0,001	30.2%	22.7%
2002	660	197	29.8%	2.98	2.4	<0,001	27.5%	21.9%
2003	703	175	24.9%	2.32	2.0	<0,001	22.8%	20.6%
Total	17721	4517	25.5%				Mean= 25.8%	Mean= 21.2%

TSCN : Term Single cephalic nullipara

Table 1. Trends of number of deliveries, rates and risks of cesarean delivery during the study period.

3.2 Cesarean delivery rates

Observed rates of cesarean delivery and relative risk are presented in table 1 above. The coefficient of variation for overall cesarean delivery rates was 27.9, and the ratio of the highest (36.9%) to the lowest (12.5%) was 2.95, indicating significant variability in overall cesarean delivery rates during the 19 years. Using year 1985 as the reference, we noted a striking increase in the cesarean delivery rate through out the study period. Since 1991, the

cesarean delivery rate has been sustained at least 100% above that in 1985. Trends in cesarean delivery rates accounting for sociodemographic characteristics and obstetric history are presented in table 2. Globally, cesarean delivery rates increased ($p<0.05$). Observed cesarean rates were relatively higher in the 35 – 50 years old age group, Bambara ethnic group, grandmultiparas, women residing outside of Bamako, and those referred from other health centers. Cesarean delivery rates for unbooked pregnancies varied between 24.5% and 45.0%. Rates for women who followed antenatal screening varied between 15.6% and 31.0%.

3.3 Indications of cesarean delivery

In practice, the decision to perform a cesarean relies on an array of parameters. There is no general consensus universally accepted way of reporting cesarean delivery indications. Absolute numbers and specific cesarean delivery rates per indication / risk factors for cesarean delivery appeared in table 3. We report here 3 systems of reporting these indications:

3.3.1 Classification of cesareans by mutually exclusive clinical indications

Two independent obstetricians were asked to review our database and to point out what was the major factor leading to the decision of cesarean. They reviewed together cases where they found different factors. The results are presented in table 2 below. Of note, pelvic contraction and suspected fetal distress were the most represented and showed an increasing pattern over time.

Indications	1985 – 1990 N=1033	1991 – 1995 N=1577	1996 – 1997 N=319	1998 – 2001 N=1216	2002 – 2003 N=372
Contracted /deformed pelvis	22.2%	22.1%	19.8%	24.2%	26.6%
Uterine rupture	13.7%	17.8%	9.6%	7.4%	4.4%
Major antepartum hemorrhage	5.8%	5.8%	8.3%	4.2%	4.1%
Transverse lie	11.7%	8.2%	7.7%	6.2%	4.7%
Brow presentation	1.9%	0.9%	1.2%	1.1%	0.8%
Prolonged labor	9.7%	4.8%	7.4%	6.5%	7.4%
Previous cesarean	4.1%	3.5%	4.6%	5.5%	10.4%
Previous obstetric fistula	1.3%	0.6%	1.2%	0.5%	1.9%
Suspected fetal distress	22.8%	28.0%	25.9%	29.9%	26.6%
Maternal diseases	3.6%	5.9%	10.8%	12.2%	8.2%
Breech presentation	3.1%	2.4%	3.4%	3.2%	5.5%

Table 2. Trends in the contribution of eleven mutually exclusive clinical indications.

3.3.2 Classification of Baltimore group on cesarean indications

This classification system separates cesarean indications into absolute, maternal, and non-absolute indications. Absolute maternal indications include obstructed labor (including severe deformed pelvis and failed trial of labor), major antepartum hemorrhage and grade 3 or 4 placenta previa, malpresentation (including transverse, oblique, and brow), and uterine rupture. Non-absolute indications include failure to progress in labor (including prolonged labor); failed induction; previous cesarean delivery; genitourinary fistula or third-degree tear repair; antepartum hemorrhage, (excluding those for absolute indications and including abruptio placentae); maternal medical diseases; severe preeclampsia or eclampsia; psychosocial indications including maternal request, ''precious'' pregnancy; fetal compromise (including fetal distress, cord prolapse, and severe intrauterine growth retardation); and breech presentation.

Globally 66.3% of cesarean deliveries during the 19 years were performed for absolute maternal indications (2993/4517) vs 33.7% for non-absolute indications (1524/4517). The percentage of absolute maternal indications evolved as follow: 66.8% for 1985 – 1990, 74.6% for 1991 – 1995, 63.6% for 1996 – 1997, 59.5% for 1998 – 2001 and 53.8% for 2002 – 2003 ($p<.001$).

Uterine rupture, an absolute indication for cesarean delivery occurred in 2.6% of all the 17721 deliveries and was the indication of 10.1% of the 4517 cesarean deliveries. The time trends of uterine rupture were as follow: 1.8% of all deliveries recorded in 1985 – 1990, 3.9% for 1991 – 1995, 2.7% for 1996 – 1997, 1.5% for 1998 – 2008 and 0.7% for 2002 – 2003. Of all women with uterine rupture, 94.7% of cases were diagnosed at admission examination in referred patients (92.5% with patients referred emergently).

Uterine rupture occurred in 87.4% (415/475) of cases in an unscarred uterus vs 12.6% (60/475) in a scarred uterus. Observed risk factors for primary uterine rupture included: contracted pelvis, 12.0% (57/475); fetal macrosomia 9.7% (46/475); contracted pelvis associated with macrosomia 3.4% (16/475). Malpresentation was recorded in 12.4% (59/475). Dystocia associated with oxytocin and / or traditional medicines labor augmentation has been observed in 12.6% of cases (60/475). Grandmultiparity (≥7 deliveries in obstetric history) accounted for 12.4% (59/475) of all uterine ruptures while short interpregnancy interval has been observed in 12.0% of all uterine ruptures (57/475). Central placenta previa and twin pregnancy accounted for 1.9% (9/475) each while abruptio placentae has been observed in 1.1% (6/4475). Finally, the cause of 8% of uterine ruptures was unknown (38/475). For cases of uterine rupture secondary to a uterine scar, previous cesarean delivery was the most represented, 11.4% (54/475) followed by previous uterine rupture, 1.3% (6/475). No case of uterine rupture secondary to previous myomectomy was reported.

Six conditions representing 86.2% of cesareans for non-absolute indications included: suspected fetal distress (33.7%), previous cesarean delivery (25.6%), breech presentation (10.1%), eclampsia (5.9%) genitourinary fistula (5.9%) and twin pregnancy (5.1%). Percentages of cesarean deliveries for genitourinary fistula, twin pregnancy, and fetal distress did not show a clear trend. The contributions of breech presentation, eclampsia and

previous cesarean delivery, however, increased over time. In 1985 – 1990, 2.90% of cesarean deliveries were performed primarily because of breech presentation; this rate reached 5.64% during 2002 – 2003. These rates were 1.06% and 4.30% respectively for eclampsia and 7.84% and 16.66% for previous cesarean delivery.

Three major indications, when present, gave a 70%-90% likelihood that the woman would receive cesarean. These included cephalopelvic disproportion (CPD), malpresentation, and previous cesarean delivery. 64-85% of women with antepartum hemorrhage were delivered by cesarean section. These four indications accounted for 66.5% of all cesarean deliveries.

Characteristics	1985 - 1990 N=6070	1991 – 1995 N = 5488	1996 – 1997 N = 1045	1998 – 2001 N=3755	2002 – 2003 N=1363
Age groups					
13 – 19 yrs	15.9% (1088)	25.2% (1113)	27.2% (180)	31.6% (707)	24.5% (257)
20 – 34 yrs	16.5% (4087)	28.3% (3558)	28.9% (718)	31.6% (2473)	26.8% (890)
35 – 50 yrs	19.2% (895)	33.5% (817)	40.8% (147)	36.4% (575)	31.8% (216)
Ethnic groups					
Bambara	18.2% (2649)	32.5% (2462)	31.3% (460)	35.4% (1572)	32.2% (605)
Peuhl	18.1% (895)	27.4% (828)	30.1% (163)	31.2% (574)	27.8% (194)
Malinke	15.4% (930)	28.3% (736)	32.6% (129)	33.2% (446)	22.9% (123)
Soninke	17.4% (471)	27.4% (402)	28.8% (80)	28.3% (364)	16.7% (131)
Dogon	14.4% (180)	19.6% (214)	20.0% (50)	23.3% (219)	24.4% (90)
Sonrhaï	12.5% (256)	25.1% (183)	43.2% (37)	32.0% (122)	20.0% (41)
Senoufo	15.0% (100)	18.6% (97)	26.9% (26)	27.2% (81)	21.4% (30)
Bobo	13.0% (130)	15.4% (123)	25.0% (24)	29.3% (41)	22.2% (14)
Bozo	24.4% (45)	25.3% (79)	45.5% (11)	23.7% (38)	14.3% (18)
Maure	15.4% (13)	17.3% (52)	40.0% (5)	31.4% (51)	9.5% (21)
Minianka	23.3% (30)	19.3% (57)	0% (6)	43.5% (23)	21.3% (21)
Others	17.0% (371)	25.9% (255)	27.8% (54)	31.3% (224)	27.3% (75)
Region					
Bamako	11.7% (5265)	18.1% (4194)	23.4% (798)	25.3% (2794)	20.5% (1088)
Kayes	54.2% (24)	56.3% (48)	87.5% (8)	50.0% (24)	80.0% (5)
Koulikoro	51.5% (701)	63.3% (1108)	53.1% (213)	53.8% (865)	55.2% (262)
Sikasso	64.8% (54)	74.1% (81)	46.2% (13)	48.3% (29)	00.0% (5)
Segou	35.3% (17)	59.0% (39)	50.0% (10)	45.8% (24)	33.3% (3)
Mopti	40.0% (5)	33.3% (9)	00.0% (1)	37.5% (8)	00.0% (0)
Others	00.0% (4)	55.6% (9)	50.0% (2)	36.4% (11)	-----
Parity					
0	18.3% (1481)	28.9% (1376)	29.2% (295)	33.5% (1089)	25.2% (359)
1 – 6	16.4% (3906)	27.2% (3559)	30.3% (669)	31.5% (2417)	28.3% (918)
≥ 7	16.3% (683)	35.4% (553)	33.8% (81)	35.4% (249)	22.9% (86)
Antenatal booking					
Yes	15.6% (5218)	17.0% (4334)	28.1% (881)	31.0% (3222)	26.3% (1188)
No	25.9% (852)	24.5% (1154)	45.0% (164)	40.5% (533)	33.7% (175)

Characteristics	1985 - 1990 N=6070	1991 – 1995 N = 5488	1996 – 1997 N = 1045	1998 – 2001 N=3755	2002 – 2003 N=1363
Referral status					
Emergency Ref	59.7% (827)	73.6% (1149)	59.8% (241)	60.1% (826)	62.9% (214)
Non emergency ref.	55.4% (496)	45.2% (662)	65.3% (95)	47.8% (695)	69.8% (149)
Self referral	5.6% (4747)	11.9% (3677)	15.9% (709)	17.4% (2234)	13.4% (1000)
Indications					
CPD	87.1% (470)	91.1% (731)	88.4% (129)	90.2% (553)	88.4% (172)
Antepartum hemorrhage	64.7% (150)	75.4% (203)	84.3% (46)	64.8% (128)	75.9% (29)
Malpresentation	72.2% (212)	85.0% (234)	87.8% (234)	86.7% (135)	81.6% (38)
Breech presentation	32.9% (155)	44.2% (206)	48.1% (52)	51.1% (180)	41.0% (78)
Hypertension	23.3% (227)	42.7% (330)	53.5% (86)	42.0% (441)	30.3% (145)
Eclampsia	29.7% (37)	63.9% (36)	59.1% (22)	53.1% (64)	69.2% (26)
Diabetes in pregnancy	25.0% (8)	38.1% (21)	50.0% (2)	55.6% (18)	62.5% (8)
Previous uterine rupture					
Previous cesarean	100% (7)	88.9% (9)	100% (1)	80% (5)	----
Obstetric fistula treated	73.7% (278)	74.9% (458)	82.5% (97)	77.8% (451)	81.6% (179)
Uterine prolapse treated	85.4% (48)	81.0% (42)	90.0% (10)	96.2% (26)	100% (16)
Cord prolapse	78.6% (14)	86.7% (15)	100% (2)	81.8% (11)	0.0% (2)
Cardiac disease	54.8% (42)	67.3% (52)	80.0% (5)	75.0% (32)	25.0% (4)
Post-term (induction)	7.7% (13)	60.0% (15)	50.0% (2)	37.0% (27)	0.0% (8)
Suspected Fetal distress	39.4% (33) 36.4% (772)	57.8% (45) 48.1% (1142)	57.1% (7) 48.4% (213)	64.2% (34) 51.2% (732)	52.6% (19) 51.2% (205)
Twin pregnancy	24.8% (149)	32.9% (152)	33.3% (33)	41.5% (106)	37.5% (40)
PROM	32.7% (110)	55.3% (170)	64.3% (28)	50.0% (164)	31.4% (86)
Preterm labor	17.0% (570)	24.5% (486)	32.2% (115)	28.9% (419)	23.4% (124)

CPD: cephalopelvic disproportion Antepartum hemorrhage: placenta praevia and placental abruption.
PROM: Premature rupture of membranes
Percentages represents the cesarean delivery rate for each category. Numbers between parentheses correspond to the total number of delivery in each category.

Table 3. Trends in cesarean delivery rates (total number of deliveries in each category) for sociodemographic, pregnancy and delivery characteristics by time period.

3.3.3 Robson's ten group classification

To further examine trends in cesarean delivery according to patient demographics, we classified our population following Robson's rules (table 4). Collectively, groups 1, 3 and 5 constituted 78.2% of deliveries. Their cesarean delivery rates are 22.6%, 13.2% and 76.4% while their contributions to total cesarean deliveries were respectively 18.14%, 26.54% and 20.86%. Although group 2 and 4 had high levels of cesarean delivery rates (91.9% and 46.3% respectively), they contributed only 8.95% of total cesarean deliveries.

Trends in cesarean delivery rates for each of the ten groups appear in figure 2. There were no significant changes in abdominal delivery for Robson's group 2 (Nulliparous, single gestation, cephalic presentation, ≥ 37 weeks gestational age, induced or cesarean delivery before labor) and group 5 (Previous cesarean delivery, single gestation, cephalic presentation, ≥ 37 weeks gestational age). We observed an increasing cesarean delivery rates for groups 4, 8 and 9. Group 9 presented a two pattern aspect with rates shifting from around 75% before 1990 to around 85% thereafter.

To further understand variations in obstetric practice in our hospital, groups 1 (spontaneously laboring term nulliparas) and 2 were combined as a composite variable, the term TSCN (table 1). The annual TSCN cesarean delivery rate and contribution of TSCN to hospital deliveries are documented in Table 1. The mean cesarean delivery rate in TSCN was 25.8% (range, 10.3% –40.7%). The CV for TSCN cesarean delivery rates was 29.5%, again indicating significant variation between different years. The 19 year trends of cesarean delivery rate in TSCN follows a pattern similar to that of overall cesarean delivery rate (Table 1). Figure 1 demonstrates positive correlation between the overall and TSCN cesarean delivery rates over time (Slope = 0.876). Linear regression model suggested that 77% of the variation of the overall cesarean delivery rates can be explained by the variation observed in TSCN cesarean delivery rates ($p<0.001$). Our analyses suggest that the increase in overall cesarean delivery rate was not related to changes in obstetric groups since the proportion of all deliveries that were TSCN did not vary substantially. The average proportion of TSCN in this study was 21.2% (range, 18.3 –24.4%) with a coefficient of variation of only 8.4% (Table 1).

Of note, 57.9% of cesareans in the TSCN group were indicated because of CPD (this represented 31.4% of all cesareans for CPD). One third of all cesarean deliveries indicated for eclampsia occurred in TSCN but this contributes only 3.2% to TSCN cesarean deliveries.

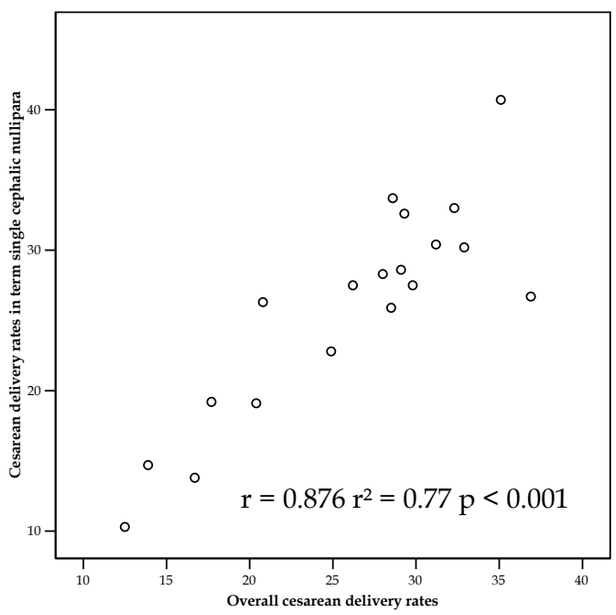

Fig. 1. Correlation between overall cesarean delivery rates and cesarean delivery rates in TSCN.

Robson's classification	Prevalence[1] % of Robson groups	Cesarean delivery[2]	Contribution of each group to total cesarean delivery[3].
Group 1. Nulliparous, single cephalic, ≥ 37 weeks, in spontaneous labor	20.3%	22.6%	18.14%
Group 2. Nulliparous, single cephalic, ≥ 37 weeks, induced or CS before labor	1%	91.9%	3.82%
Group 3. Multiparous (excluding prev. CS), single cephalic, ≥ 37 weeks, in spontaneous labor	51%	13.2%	26.54%
Group 4. Multiparous (excluding prev. CS), single cephalic, ≥ 37 weeks, induced or CS before labor	2.8%	46.3%	5.13%
Group 5. Previous CS, single cephalic, ≥ 37 weeks	6.9%	76.4%	20.86%
Group 6. All nulliparous breeches	0.8%	39.6%	1.27%
Group 7. All multiparous breeches (including prev. CS)	2.3%	45.1%	4.08%
Group 8. All multiple pregnancies (including prev. CS)	2.5%	29.7%	2.94%
Group 9. All abnormal lies (including prev. CS)	2.9%	80%	9.11%
Group 10. All single cephalic, ≤ 36 weeks (including previous CS)	9.5%	21.6%	8.06%
Total	N= 17721	-	N= 4517

[1]Calculated by total women in each group by the total number of deliveries
[2]Calculated by dividing the total number of cesarean in each group by the total number of women in each group
[3].Calculated by dividing numbers of cesarean per group by the total number of cesarean delivery (N=4517)

Table 4. Prevalence of Robson ten groups ; cesarean delivery rate by group and contribution of each group to cesarean delivery.

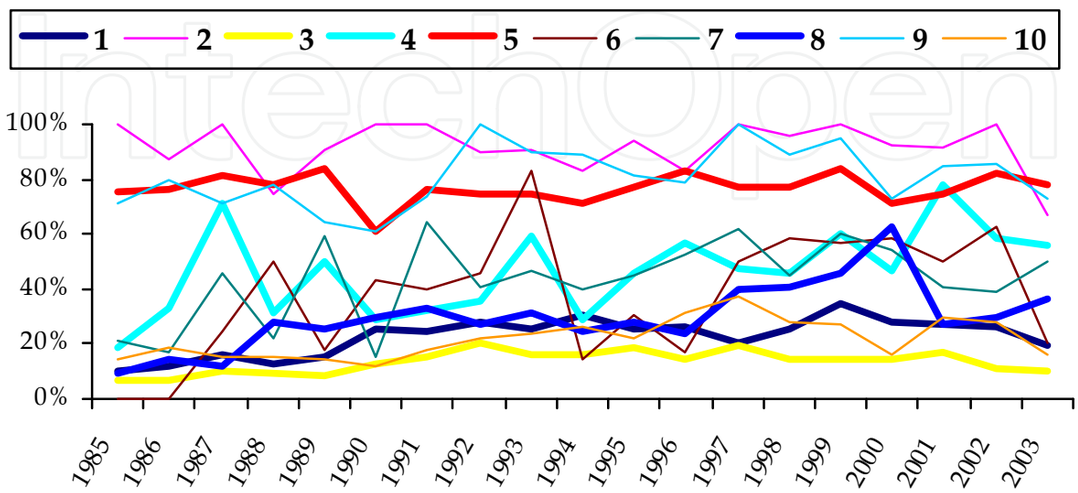

Fig. 2. Nineteen year trends of cesarean delivery rates per Robson's group.

3.4 Multivariate analysis

Finally, we performed multilogistic regression with sequential adjustment to identify explanatory factors for increased cesarean delivery rates. Unadjusted analysis revealed a 100% increase in the rates of cesarean delivery (2003 vs 1985, RR = 2). The best model identified referral status, cephalopelvic disproportion and history of previous cesarean delivery as 3 factors to account for the observed increases in overall cesarean delivery rates. However, this model explained less than half of the observed increase (Figure 4). Of note, controlling for maternal age, parity and marital status didn't affect the observed increase. Controlling for cephalopelvic disproportion alone explained 32% of the increase since we found an adjusted relative risk of 1.68. Adjusting simultaneously for cephalopelvic disproportion, referral status and previous cesarean delivery further decrease the adjusted relative risk to 1.58. We couldn't build another model better than this last one.

As expected, higher levels of abdominal delivery were observed in referred patients (table 2). Since 1986, 60 to 70% of emergency admissions during labor have resulted in cesarean delivery. The cesarean delivery rates for referred patient without emergency fluctuated from 40%-60%. Cesarean delivery rates for direct admissions were ≤ 10% before 1994 and 10-20% thereafter (figure 3).

Cephalopelvic disproportion was a common indication for cesarean delivery, with a mean rate of 39.6% of women delivering abdominally having some degree of CPD. The percentage of CPD in cesarean deliveries ranged from 30.3% in 1985 to 48.8% in 1999. Contracted pelvis constituted 87% of all CPD. Of note, 63.5% of all contracted pelvis were recorded in the referred patients, who generally came from poor rural environments. The high incidence of uterine rupture among this group may correlate with severity of pelvis contraction.

There were 1465 deliveries in which the mother had a history of previous cesarean delivery. An elective cesarean delivery was decided for 858. Common indications for elective cesarean delivery were cephalopelvic disproportion (n=655), abnormal fetal presenting part (112), history of vesico-vaginal fistula (n=36), history of uterine prolapse (n=4), "precious" pregnancy (n=4), post-term pregnancy (n=7), and premature rupture of membranes (n=40). Among the 607 suitable for a trial of scar, 120 were emergency referrals with conditions such as a bleeding placenta praevia, a sudden rise in the blood pressure/eclampsia, or a suspected fetal distress leading to an emergency cesarean delivery. Finally, only 487 trials of scar have been undertaken (one third of all scarred uteri). We recorded 244 vaginal deliveries (50.1%) while 243 were emergency cesarean delivery (49.9%). Two (2) cases of uterine dehiscence occurred (0.4% of the 487 trials of scar) and 1 case of maternal death (0.2%, denominator = 487 trials of scar). There were 25 perinatal deaths (5.1%).

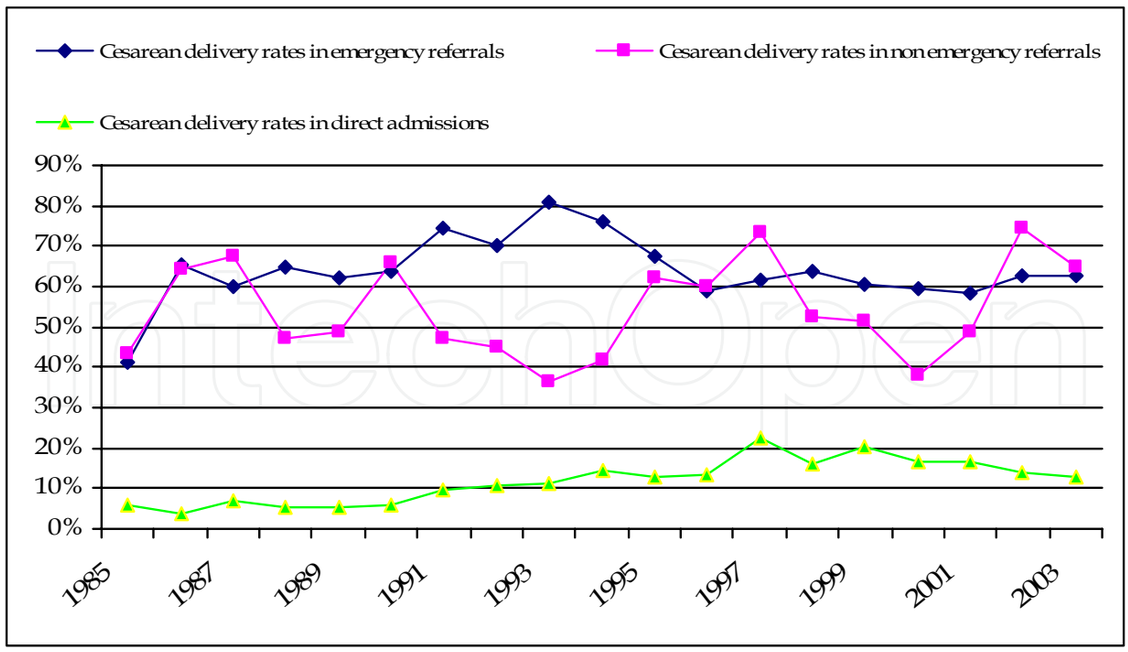

Fig. 3. Trends in cesarean delivery rates by referral status.

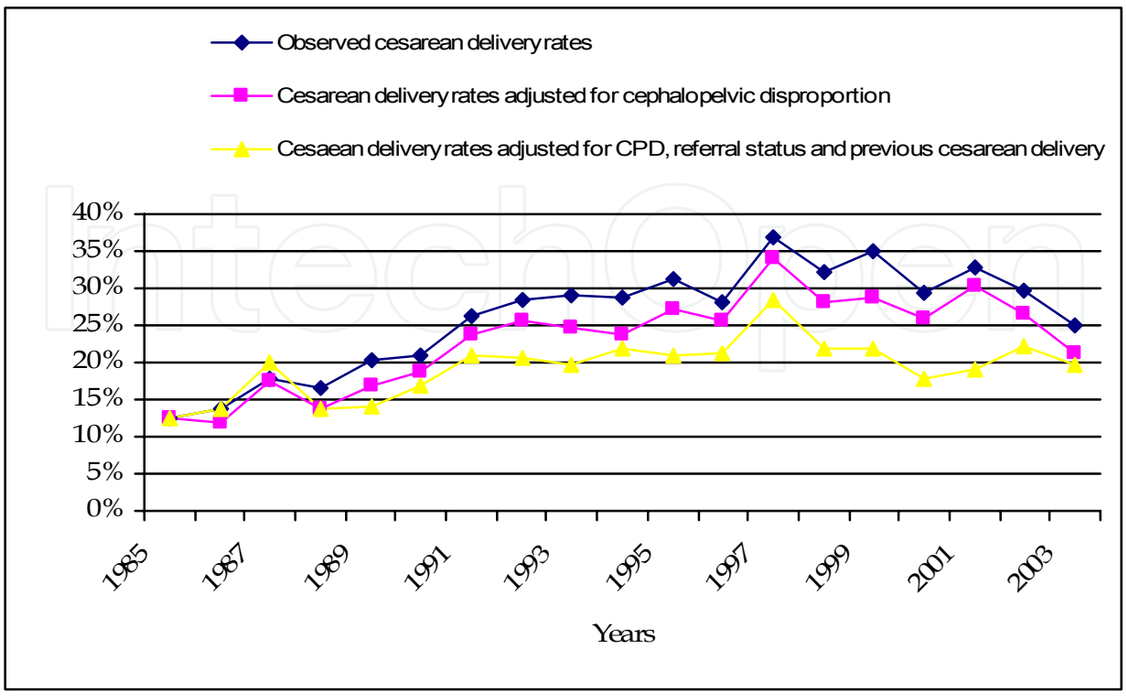

Fig. 4. Observed rates of cesarean delivery and sequentially adjusted rates for changes in cephalopelvic disproportion, mode of admission and history of cesarean delivery.

3.5 Complications of cesarean delivery

3.5.1 Maternal complications

3.5.1.1 Intraoperative surgical complications

We defined intraoperative complications as laceration of the uterus (uterine rupture included), cervix, bladder, vagina or bowel, intraoperative blood loss of ≥1000 ml, blood transfusion, and hysterectomy. Overall, 13.2% (596/4517) of the women undergoing a cesarean delivery had at least one of the above complications. The most common events were uterine rupture (9.2%, 417/4517), hemorrhage (2.4%, 111/4517), hysterectomy (2.1%, 96/4517); urinary tract injury (0.4%, 18/4517), and anesthesia-related complications (0.3%, 15/4517).

Table 5 presents an analysis of factors influencing the occurrence of intraoperative complications. Univariate analyses found four risk factors for intraoperative complications: admission during the active phase of labor (cervical dilatation ≥4cm), transverse lie, total length of labor more than 24 hours, and emergent referrals. However, in multivariate analyses, only emergent referral remained a significant risk factor with a 3.4 folds increase in the odds of intra-operative adverse events. Removing referral status from the multivariate analysis allowed two factors to be linked to intraoperative complications: ruptured membranes at admission (OR=2.1 [1.2 – 3.7], $p<0.01$) and total length of labor (OR=1.9 [1.1 – 3.5], $p<0.05$).

Factors	Crude OR	95% CI OR	P	AOR	95% CIAOR	p
Cervical dilatation at time of intervention						
0 – 3 cm	Reference	---	---	Ref	---	---
4 – 10 cm	2.5	1.9 – 3.1	<0.001	1.6	0.8 – 2.9	>0.05
Fetal presentation						
Cephalic	Reference	---	---	Ref	---	---
Breech	0.8	0.6 – 1.2	>0.05	0.8	0.2 – 2.7	>0.05
Transverse	1.5	1.1 – 1.9	<0.05	0.9	0.4 – 2.1	>0.05
Total length of labor						
<12 hours	Reference	---	---	Ref	---	---
12 – 24 hours	1.4	0.9 – 2.1	>0.05	0.9	0.5 – 1.6	>0.05
>24 hours	3.5	2.3 – 5.3	<0.05	1.5	0.8 – 2.8	>0.05
Membranes status						
Not ruptured	Reference	---	---	Ref	---	--
Ruptured	3.0	2.4 – 3.8	<0.001	1.5	0.8 – 2.8	>0.05
Preterm delivery						
No	Reference	---	---	Ref	---	---
Yes	0.6	0.4-0.9	<0.001	0.3	0.1 – 0.4	>0.05
Referral status						
Self-referred	Reference	---		Ref	---	
Referred with emergency	5.1	3.9 – 6.5	<0.001	3.4	1.7 – 6.8	<0.001
Referred without emerg.	0.7	0.4 – 0.9	<0.01	0.8	0.2 – 2.9	>0.05
Body mass index						
<35.0 kg/m²	Reference	---	Ref	---	---	--
≥ 35 Kg/m²	1.3	0.5 – 2.9	>0.05	2.1	0.4 – 10.2	>0.05
Intraoperative adhesions						
No	Reference	---	Ref	---	---	---
Yes	0.8	0.6-1.2	>0.05	1.7	0.8 – 3.9	>0.05

CI: confidence interval OR: odds ratio AOR: adjusted odds ratio CIAOR: confidence interval of the adjusted odds ratio

Table 5. Risk factors for intraoperative surgical complications.

3.5.1.2 Post-cesarean complications

Post-cesarean infection

The incidence of post-partum infection among cesarean deliveries was 20.1% (910/4517) compared to 3.9% (509/13204) for vaginal deliveries (OR= 6.3 [5.6 – 7.1], p<0.001). Of the 4517 cesarean deliveries, 17.5% (790/4517) met the criteria for surgical site infection as defined by CDC. Endometritis, peritonitis, post-partum urinary tract infection and serious infectious morbidity were more linked to abdominal route of delivery (table 6).

Risk factors for post-cesarean infection identified in a univariate analysis were: emergent referral, younger maternal age (13 – 19 years old), nulliparity, ruptured membranes at admission, abnormal amniotic fluid coloration, and prolonged labor (total length ≥ 12 hours). In multivariate analyses, only 3 factors remained significantly associated with postpartum infection: abnormal amniotic fluid coloration, ruptured membranes before admission and duration of labor >24 hours (table 7).

	Cases per Cesarean Delivery (%), n=4517	Cases per Vaginal Delivery (%), n=13204	OR (95% CI)
Endometritis	11.1 (n=500)	3.3 (n=436)	3.6 [3.2 – 4.2]
Wound infection	6.8 (n=305)	---	---
Peritonitis	4.0 (n=18)	0.02 (n=2)	26.4 [6.1 - 113.9]
Urinary tract infection	0.7 (n=35)	0.2 (n=24)	4.3 [2.5 – 7.2]
Serious infectious morbidity¥	2.7 (n=123)	0.1 (n=8)	46.2 [22.6 – 94.5]

¥Defined as bacteremia, septic shock, septic thrombophlebitis, necrotizing fasciitis; peritonitis, or death attributed to infection

Table 6. Post-Partum Infectious Complications by Delivery Route.

Postpartum hemorrhage: Recorded rates were comparable between cesarean delivery and vaginal delivery, 1.7% vs 1.4% (P>0.05).

Deep venous thrombosis. Only 11 cases have been recorded during the study period; 9 in cesarean deliveries vs 2 in vaginal deliveries (OR = 13.2 [2.8 – 61.0]).

Puerperal psychosis. In 19 years, 6 cases occurred, 5 after cesarean delivery and 1 post-vaginal delivery (OR = 14.6 [1.7 – 125.3].

Risk factors	Unadjusted Odds ratio	95% CI	P	AOR	95%CI	P
Referral status						
Self admission	1.0	1.3 – 1.9	<0.01	1.0	0.6 – 1.3	>0.05
Referred emergently	1.6	0.4 – 0.7	<0.01	0.9	0.5 – 1.5	>0.05
Referred without	0.5			0.9		
Maternal age						
20 – 34 years	1.0	1.1 – 1.6	>0.01	1.0	0.5 – 1.6	>0.05
13 – 19 years	1.4	0.7 – 1.1	>0.05	0.9	0.9 – 1.8	>0.05
35 – 50 years	0.9			1.1		
Parity						
1 – 6	1.0	1.1 – 1.4	< 0.05	1.0	0.4 – 1.8	>0.05
Nulliparous	1.2	0.8 – 1.3	>0.05	0.8	0.7 – 1.5	>0.05
≥ 7	1.0			1.02		
Body Mass Index (BMI)						
<35 Kg/m²	1.0	0.2 – 0.9	<0.05	1.0	0.2 – 2.1	>0.05
≥35 Kg/m²	0.4			0.6		
Membranes status at admission	1.0	2.8 – 3.9	<0.001	1.0	1.3 – 3.7	<0.01
Non ruptured	3.3			1.9		
Ruptured						
Amniotic fluid color at admission	1.0	2.7 – 3.9	<0.001	1.0	1.5 – 3.2	<0.001
Normal	3.3			2.2		
Abnormal						
Cervical dilatation at admission	1.0	1.2 – 1.7	<0.001	1.0	1.01 – 2.1	<0.05
0 – 3 cm	1.8			1.4		
4 – 10 cm						
Duration of labor						
< 12 hours	1.0	1.1 – 1.9	<0.05	1.0	0.9 – 1.9	>0.05
12 – 23 hours	1.4	1.9 – 3.6	<0.05	1.3	1.4 – 3.4	<0.001
≥ 24 hours	2.7			2.2		
Induction of labor						
No	1.0	0.6 – 1.8	>0.05	1.0	0.3 – 3.6	>0.05
Yes	1.04			1.1		
Antepartum hemorrhage						
No	1.0	0.1 – 0.3	<0.001	1.0	0.01 – 0.4	<0.01
Yes	0.2			0.05		
Per/postpartum hemorrhage	1.0	0.9 – 2.5	>0.05	1.0	0.3 – 4.1	>0.05
No	1.5			1.1		
Yes						

CI = Confidence Interval AOR: Adjusted odds ratio

Table 7. Risk factors for post-partum infection.

3.5.1.3 Maternal mortality and cesarean delivery

During the 19 year period, 417 maternal deaths were recorded. Among these maternal deaths, 348 occurred per or postpartum (83.4%). The majority of these delivery period deaths, 70.1% (244/348), were associated with cesarean delivery. Thus, 5.4% (244/4517) of cesarean deliveries resulted in a maternal death. The corresponding rate for vaginal delivery was 0.9% (104/13204).

Twelve of the 244 maternal deaths associated with cesarean delivery occurred before the intervention was performed (4.9%). A similar proportion occurred during cesarean. The vast majority of maternal deaths were recorded in the post-cesarean period (90.1%).

The absolute number and risk of cesarean-related maternal deaths shows a sharp decrease beginning in 1994 (Figure 5).

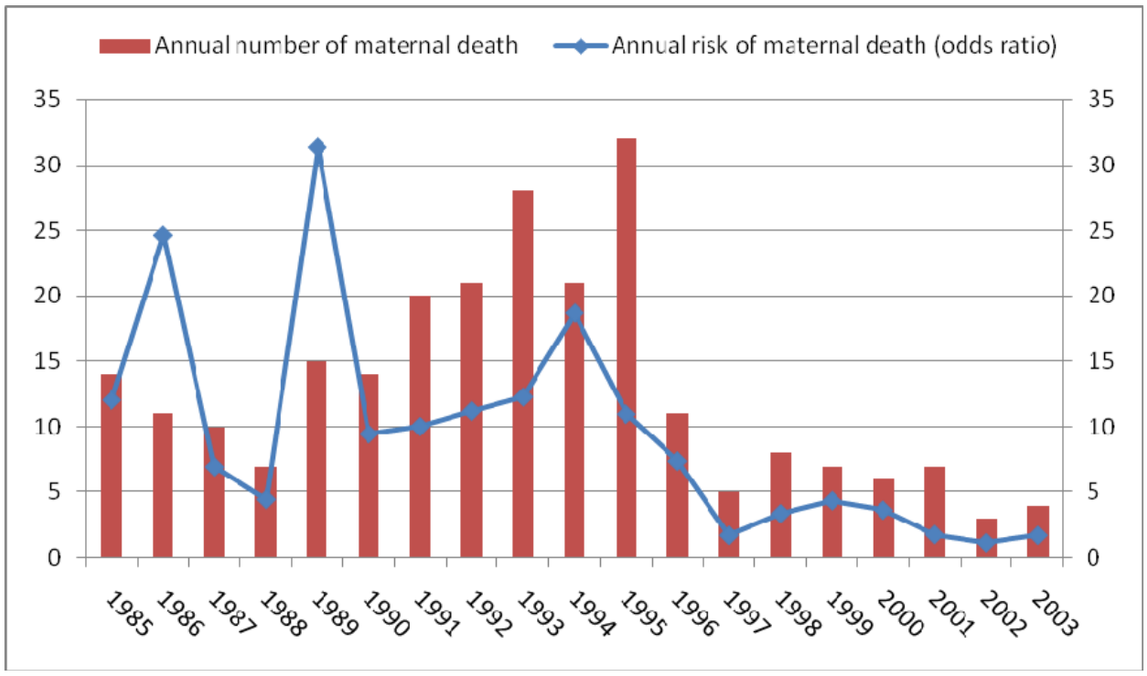

Fig. 5. Trends of annual number and risk of cesarean related maternal deaths.

Table 8 presents case fatality rates for direct and indirect maternal complications by route of delivery. The vast majority of maternal complications (91.8% for cesarean delivery, 83.9% for vaginal delivery) and maternal deaths (95.5% for cesarean delivery, 87.5% for vaginal delivery) were the consequences of direct maternal complications. The overall case fatality rate was 6.9% (244/3548) for cesarean delivery compared to 2.9% (104/3597)

for vaginal delivery. In the cesarean delivery group among direct maternal complications, uterine rupture had the highest fatality rate (23.2%). There was a consistent decrease in the incidence and case fatality rates of uterine rupture in women delivered abdominally (figure 6). The incidence decreased from 10.5% for the period 1985 – 1990 to 4.5% for the period 2002 – 2003. The case fatality rates decreased from 29.9% to 6.9% in the same time periods.

Causes	CESAREAN DELIVERY			VAGINAL DELIVERY		
	Total number	Death	Case rate fatality	Total number	Death	Case rate fatality
Direct maternal complications						
hemorrhage	377	45	11.9%	491	40	8.1%
Hypertension and complications	374	17	4.5%	1196	24	2.0%
Dystocia	1096	5	0.5%	475	2	0.4%
Uterine rupture	455	101	23.3%	20	0	0.0%
Postpartum infection	910	57	6.2%	480	25	5.2%
Other direct causes	45	8	17.8%	356	0	0.0%
Indirect maternal complications						
HIV	6	0	0.0%	7	0	0.0%
Malaria	135	0	0.0%	170	2	1.2%
Hemoglobinopathy	24	1	4.2%	49	0	0.0%
Anemia	43	1	2.3%	215	0	0.0%
Cardiac disease	25	7	28.0%	59	5	8.5%
Diabetes	17	0	0.0%	23	0	0.0%
Hepatitis	1	0	0.0%	5	0	0.0%
Other indirect causes	40	2	5.0%	51	6	11.8%
Total	3548	244	6.9%	3597	104	2.9%

Table 8. Absolute numbers of cases, number of deaths and case fatality rates of direct and indirect maternal complications for cesarean delivery and vaginal delivery.

We examined the relationship between cesarean delivery and maternal death in the context of other known primary predictors (table 9). Cesarean delivery remained strongly associated with maternal death even after controlling for antenatal screening, referral status, maternal age, parity, abruption, placenta previa, hypertensive disorders, and malpresentation.

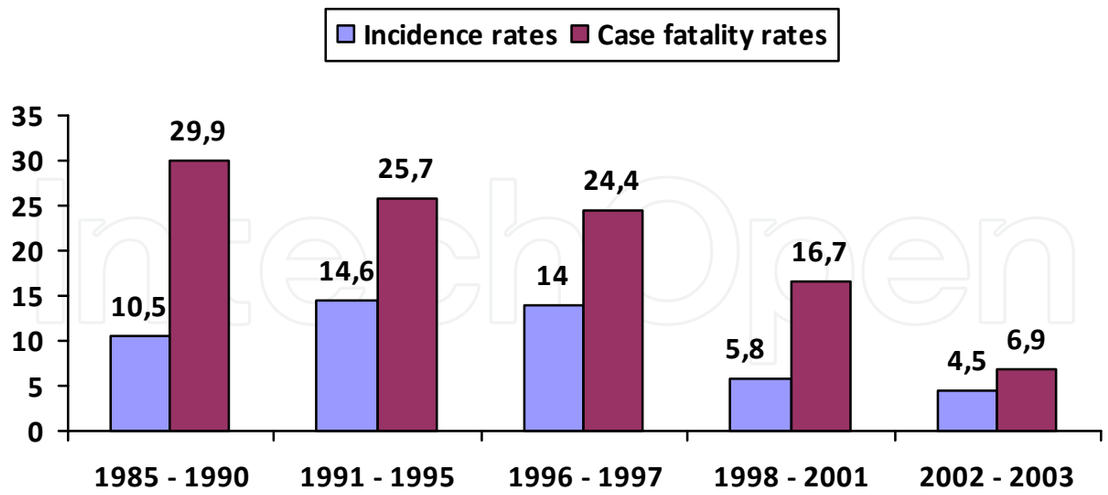

Fig. 6. Time trends of uterine rupture incidence rate and case fatality rates among 4517 cesarean deliveries at Point national hospital, Bamako, Mali, 1985 - 2003.

Variables	Crude OR	95% CI	Adjusted OR	95% CI
Antenatal screening				
No	7.0	5.7 – 8.7		
Yes	1.0			
Referral status				
Referred emergently	25.7	18.7 – 35.4		
Referred without emergency	3.2	1.9 – 5.2		
Self admission	1.0			
Maternal age				
35 – 50 years	0.8	0.6 – 1.2		
13 – 19 years	1.6	1.2 – 2.0		
20 – 34 years	1.0			
Parity				
Nullipara	0.9	0.7 – 1.2		
Grandmultipara	1.2	0.9 – 1.8		
Multipara	1.0			
Route of delivery				
Cesarean delivery	7.2	5.7 – 9.1	2.8*	– 3.8
Vaginal delivery	1.0			

* Controlling for antenatal screening, referral status, maternal age, parity, CPD, placental abnormalities (abruption and previa), hypertensive disorders, and malpresentations.

Table 9. Odds ratios with 95% confidence interval for maternal death for primary predictors.

3.5.2 Perinatal complications

3.5.2.1 Stillbirth rates

Overall, the stillbirth rate for cesarean delivery was 19.3% vs. 7.3% for vaginal delivery ($p<0.001$). Since 2000, the gap between the two curves narrowed significantly (figure 7). Gestational age-specific stillbirth rates are shown in table 10. Preterm stillbirth rates were comparable for the two routes of delivery or higher in the vaginal route. However, there was a statistically significant difference for term stillbirth rates with higher rates observed in the cesarean delivery group. The risk of stillbirth associated with cesarean delivery was high in univariate analysis (2.9 [2.7 – 3.2]). However, after adjusting for maternal age, parity, referral status, CPD, antepartum hemorrhage, hypertension in pregnancy, malpresentation and uterine rupture, the risk disappeared and cesarean delivery ws shown to be protective against stillbirth (aOR = 0.36 [0.30 – 0.42]).

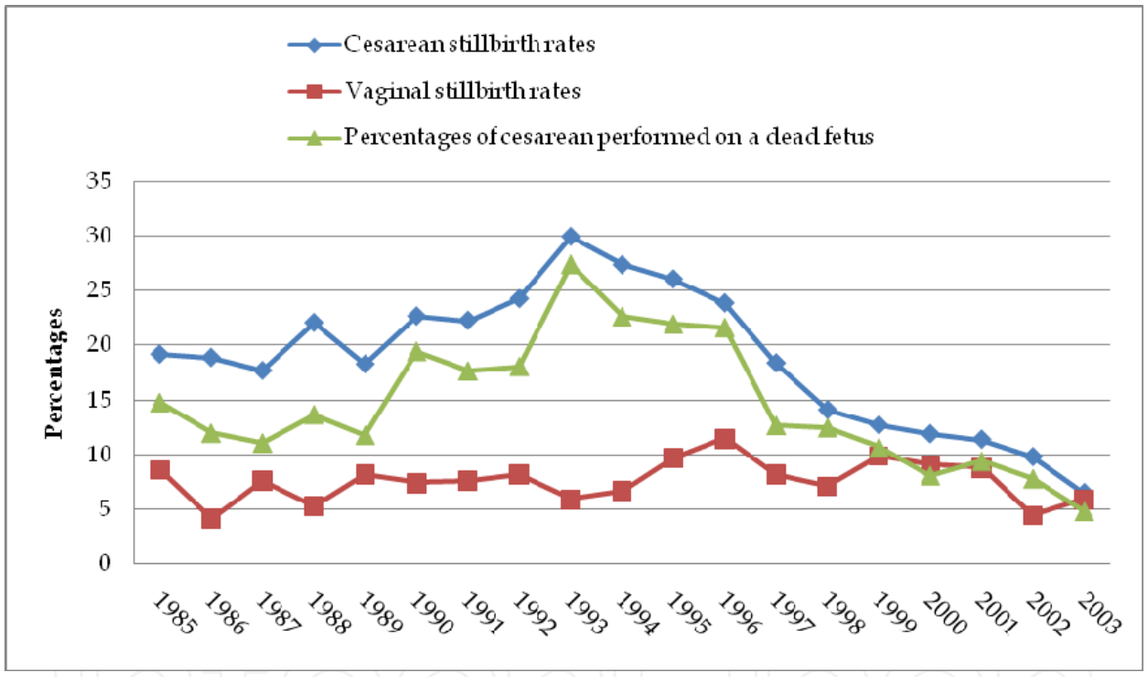

Fig. 7. Time trends of stillbirth rates for cesarean and vaginal delivery, Point G teaching hospital, 1985 - 2003.

3.5.2.2 Neonatal mortality

Neonatal mortality rates over time are shown in Figure 8. Rates were generally higher for cesarean delivery compared to vaginal delivery. Neonatal death rates didn't vary significantly over time for either route of delivery. As expected, the younger the gestational age, the higher the neonatal death rate (Table 10). Univariate analysis revealed an increased risk of neonatal death when the delivery route was abdominal as compared to vaginal route (Table 11). However, after adjusting for maternal (age, parity, referral status), pregnancy (gestational age at delivery, booking status) and fetal / neonatal (suspected fetal distress during labor characterized by an abnormal heart beat rate and / or an abnormal amnionic

fluid color, birth weight) characteristics, there was no association between cesarean delivery and neonatal death (table 11). Risk factors for neonatal death in the multivariate analysis included suspicion of fetal distress, very low birth weight and emergently referred women in labor.

	Cesarean delivery						Vaginal delivery					
Weeks of pregnancy	Total birth	Live births	Still-births	%* Still-births	N.* Deaths	% N.* Deaths	Total birth	Live births	Still-births	% Still births*	N. * Deaths	% N.* deaths
22 weeks	1	0	1	100	-	-	28	6	22	78.6	5	83.3
23 weeks	2	0	2	100	-	-	5	0	5	100	0	-
24 weeks	2	0	2	100	0	-	42	11	31	73.8	6	54.5
25 weeks	4	3	1	25.0	1	33.3	24	9	15	62.5	2	22.2
26 weeks	4	3	1	25.0	0	0.0	35	19	16	45.7	3	15.8
27 weeks	1	1	0	0.0	0	0.0	29	18	11	37.9	3	16.7
28 weeks	37	17	20	54.1	6	35.3	146	50	96	65.8	8	16.0
29 weeks	16	6	10	62.5	1	16.7	46	28	18	39.1	2	7.1
30 weeks	23	15	8	34.8	2	13.3	76	56	20	26.3	9	16.1
31 weeks	8	7	1	12.5	1	14.3	36	23	13	36.1	2	8.7
32 weeks	34	23	11	32.4	2	8.7	44	30	14	31.8	11	36.7
33 weeks	25	17	8	32.0	1	5.9	87	61	26	29.9	2	3.3
34 weeks	68	53	15	22.1	1	1.9	192	145	47	24.5	7	4.8
35 weeks	67	59	8	11.9	3	5.1	171	138	33	19.3	4	2.9
36 weeks	184	154	30	16.3	10	6.5	470	421	49	10.4	7	1.0
37 weeks	385	332	53	13.8	8	2.4	913	849	64	7.0	10	1.2
38 weeks	1390	1178	212	15.3	36	3.1	4182	3994	188	4.5	32	0.8
39 weeks	1080	866	214	19.8	19	2.2	3581	3433	148	4.1	25	0.7
40 weeks	779	609	170	21.8	24	3.9	2326	2230	96	4.1	21	0.9
41 weeks	177	133	44	24.9	5	3.8	394	380	14	3.6	3	0.8
42 weeks	103	61	42	40.2	4	6.6	122	107	15	12.3	1	0.9
>42 weeks	75	66	9	12.8	1	1.5	63	60	3	4.8	1	1.7

N. death= neonatal death. % N. death = percentage of neonatal death compute by dividing number of neonatal deaths by number of live birth. % stillbirth = percentage of stillbirth computed by dividing numbers of stillbirth by total number of birth

Table 10. Total numbers of births, stillbirth, and stillbirth rates and neonatal death for cesarean and vaginal delivery, Point G teaching hospital, 1985 -2003.

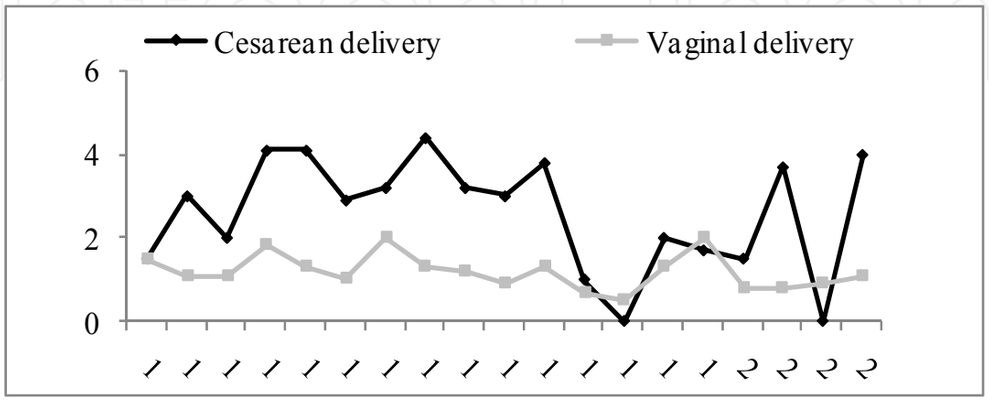

Fig. 8. Neonatal death rates for cesarean and vaginal delivery.

	Unadjusted odds ratio			Adjusted odds ratio		
Factors	OR	95% CIor	P value	AOR	95% CIaor	P value
Route of delivery						
Vaginal delivery	1.0			1.0		
Cesarean delivery	2.6	2.1 – 3.3	<0.001	0.9	0.6 – 1.2	>0.05
Antenatal booking						
Yes	1.0			1.0		
No	3.1	2.3 – 4.1	<0.001	1.5	1.1 – 2.1	<0.01
Maternal age						
20 – 34 years old	1.0			1.0		
13 – 19 years old	2.1	1.6 – 2.7	<0.001	1.3	0.9 – 1.9	>0.05
≥ 35 years old	1.3	0.9 – 1.9	>0.05	1.4	0.9 – 2.2	>0.05
Maternal parity						
1 – 6	1.0			1.0		
0	1.7	1.3 – 2.2	<0.001	1.2	0.9 – 1.7	>0.05
≥ 7	1.2	0.7 – 1.8	>0.05	0.7	0.4 – 1.3	>0.05
Referral status						
Self admission	1.0			1.0		
Referred emergently	7.6	5.9 – 9.9	<0.001	2.6	1.9 – 3.7	<0.001
Referred without emergency	2.5	1.7 – 3.6	<0.001	1.5	0.9 – 2.2	>0.05
Birth weight						
≥ 2500 grs	1.0			1.0		
500 – 999 grs	47.9	28.5 – 80.6	<0.001	8.8	3.2 – 24.3	<0.001
1000 – 1499 grs	16.1	10.6 – 24.6	<0.001	4.3	1.9 – 9.4	<0.001
1500 – 1999 grs	5.3	3.5 – 8.1	<0.001	1.6	0.8 – 3.1	>0.05
2000 – 2499 grs	1.6	1.1 – 2.4	<0.05	0.9	0.5 – 1.5	>0.05
Gestational at delivery						
≥ 37 weeks	1.0			1.0		
22 – 27 weeks	29.9	17.4 – 51.1	<0.001	2.1	0.8 – 5.8	>0.05
28 – 32 weeks	11.6	8.2 – 16.5	<0.001	2.2	1.1 – 4.6	<0.05
33 – 36 weeks	2.6	1.8 – 3.7	<0.001	1.6	0.9 – 2.9	>0.05
Antepartum hemorrhage						
Yes	4.9	3.2 – 7.7	<0.001	1.4	0.8 – 2.3	>0.05
No	1.0			1.0		
Suspect fetal distress						
Yes	20.8	14.3 – 30.3	<0.001	20.6	14.2 – 30.1	<0.001
No	1.0			1.0		

OR : odds ratio CI : confidence interval AOR : adjusted odds ratio

Table 11. Predictors of neonatal mortality, Point G national hospital, Bamako, Mali, 1985 – 2003.

4. Discussion

4.1 Strengths and limitations

We report here an analysis of deliveries during a nineteen year period in a teaching hospital in Mali (West Africa). Our main findings are: (1) a striking increase in cesarean delivery rates throughout the study period; (2) women in labor referred with an emergency condition not only constituted the largest proportion of cesarean deliveries but also this mode of admission seriously jeopardized the maternal as well as the perinatal prognosis; (3) the two most common indications for cesarean delivery were cephalopelvic disproportion and previous cesarean delivery; (4) there were very low rates of planned cesarean delivery as expressed by the small contribution of Robson groups 2 and 4.

While the majority of women delivering at Point G National Hospital originate from Bamako, the substantial proportion of women referred from other regions and the sociodemographic characteristics of the pregnant women in this setting provide a perspective on hospital-based obstetric care in the whole country up to 2003. Since 2003, Mali has instituted important changes in the delivery of obstetric care. In 2004, a nationwide emergency obstetric and neonatal care program was put in place to reinforce the perinatality program. In 2006, the Malian government began to provide medically indicated Cesarean deliveries free of charge in public hospitals and referral district health centers, increasing access and leading to subsequently higher Cesarean delivery rates (Teguete et al, 2010b). Additionally, since 2002, major staffs of the department of obstetrics and gynecology have been appointed to Gabriel Toure teaching hospital, a nearby hospital of the Malian capital city with easier accessibility. These aspects are not covered by the database used here.

Trends in Cesarean delivery rates after 2003 can be examined through an improved and adapted obstetric database installed at Gabriel Touré teaching hospital after the transfer of staff. This database contains more than 400 variables related to patients' demographic, medical and obstetric factors as well as pregnancy outcomes [Teguete et al, 2008; Teguete et al, 2009]. Rates of Cesarean delivery at the Gabriel Touré teaching hospital increased from 21% in 2003 to 32% in 2009 (Teguete I. et al, 2010b). After sequential adjustment for maternal demographic, obstetric, and referral characteristics as described above, 19% of the observed increase remained unexplained (figure 9), compared to 58.5% for the Point G database. CPD, referral status and previous cesarean delivery were the major determinants of cesarean delivery, as at Point G teaching hospital. These findings will be the core of the following comments.

4.2 Cesarean delivery rates in developing countries

The current situation of cesarean delivery rates in developing countries is very complex with large differences between countries, within countries, and between health centers [Fesseha et al, 2011; Cissé et al, 1998]. A large ecological cross-sectional study reported that, in low income countries where cesarean deliveries rates are less than 10%, as section rates increase, neonatal and maternal mortality decrease [Althabe et al, 2006]. Our database revealed a sharp increase in the rates of hospital cesarean delivery, similar to those observed in many teaching hospital maternity wards in Africa [Muganyizi & Kidanto, 2009; Geidam et al, 2009; Kwawukume, 2001]. However, countrywide cesarean delivery rates remain under the minimum level of 5% advised by the WHO for optimal obstetric care (table 12).

Rural populations remain underserved in many developing countries [Leone et al, 2008, Kizonde et al, 2006]. A recent regional meeting for the final evaluation of the "Initiative 2010" aimed at reducing maternal mortality ratios and neonatal mortality rates by 50% by 2010 reported that among 17 West and Central African countries evaluated; only five had national cesarean delivery rates of 5% or more [Ba, 2011]. Thus, in sub-Saharan Africa where coverage in healthcare service is low, initiatives to increase cesarean rates are ongoing in order to meet the millennium development goals [El-Khoury et al, 2011]. At the same time, there are calls for caution [Mbaye et al, 2011; Fesseha et al 2011] to prevent high unnecessary cesarean rates like those observed in many developed countries as well as some developing countries [Khawaja et al, 2004].

Countries	Teaching hospital	District hospital /Rural area	Country level
Tanzania	Muganyizi & Kidanto, 2009 1999: 15.1% 2005: 25.6%	Stein, 2008 1986 – 1994: 9.4% 1995 – 1999: 20.3%	Wenjuan et al, 2011 1992 – 1993: 2.9% 2004 – 2005: 4.0%
Nigeria	Ijaiya & Aboyeji 2001 1990: 3.8% 1999: 20.7% Geidam et al, 2009 2000: 7.2% 2003: 13.3% 2005: 13.9%	Ikeako, 2009 2005 – 2009 : 10.4%	Wenjuan et al, 2011 1990: 2.5% 2003: 1.9% 2008: 2.1%
Ghana	Kwawukume, 2001 1988: 25.2% 1995: 17.7% 1999: 23.8%	Buekens et al, 1998 1998 = 2.8%	Wenjuan et al, 2011 1993: 4.8% 2003: 4.4% 2008: 7.2%
Mali	Our study, 2011 1985: 12.5% 1988: 16.7% 1990: 20.8% 1999: 35.1% 2003: 24.9%	Maïga et al, 1999 1993 – 1995: 1%	El-Khoury et al, 2011 2005: 0.9% 2006: 1.6% 2007: 2.1% 2008: 2.2% 2009: 2.3%
Burkina Faso	Bambara et al, 2007 2000 : 11.3%	Buekens et al, 2003 1999 = 1.0%	Wenjuan et al, 2001 1993: 1.6% 2003: 0.7
Senegal	Cissé et al 2004 1992 : 12% 1996: 17.5% Ngom et al, 2001 2001: 25.1%	Cissé, 1998 1996 : 0.1% - 0.7%	Wenjuan et al, 2011 1992 – 1993: 2.5% 2005: 3.9%
Madagascar	Andriamady et al, 2001 1998 : 6.8%	Robitail et al, 2004 1997 : 0.7% 1999: 0.58% 2000: 0.67% 2001: 0.71%	1997: 0.6% Wenjuan et al, 2011 1993: 1.1% 2008 – 2009: 1.7%
Kenya	Wanyonyi et al, 2007 1996: 20.4% 2001: 25.9% 2004: 38.1%	Buekens et al, 2003 1993: 4.1% 1998: 5.7%	Wenjuan et al, 2011 1993: 6.0% 2003: 4.9% 2008: 7.2%
Namibia		van Dillen J, 2007 2001 – 2002 : 7.9%	Wenjuan et al, 2011 1992: 7.2% 2006 – 2007: 13.6%

Table 12. Cesarean delivery rates in different settings of selected sub-saharan african countries.

4.3 Referral system and cesarean delivery

Like in many developing countries, access to healthcare for the poor and underserved remains insufficient in Mali.

After the publication of the now famous article "Where is the M in MCH?" [Rosenfield & Maine, 1985], and the introduction of the Safe Motherhood Initiative in Nairobi in 1987, maternal mortality reduction in sub-Saharan Africa garnered increased attention and commitment [UN. Report, 1994]. In this context, maternal and child protection have become major targets in the implementation of the healthcare system by the Malian government.

Many developing countries paid special attention to the organisation of the referral system to improve maternal and child healh [Rudge et al, 2011]. Likewise, the National Perinatality Program of Mali was conceived in 1994 and organised the referral system to improve the environment of perinatal care. Reported interventions at the community level focused on (1) educational activities to raise awareness of danger signs and encourage the use of obstetric services; (2) reducing geographical and financial barriers through emergency loan schemes / subvention and (3) improving transport and communication [Kandeh et al, 1997; Nwakoby et al 1997]. This policy led to an increase in cesarean delivery rates in rural district hospitals [De Brouwere, 1997], but it was very difficult to implement in large cities like Bamako. The high incidence at Point G of uterine rupture, a preventable end stage obstetric morbidity, demonstrates the unmet needs of cesarean delivery.

Thus, like in many developing countries [Sørbye et al, 2011], access to emergency obstetric care is unsatisfactory in Mali and unequal. Despite a national obstetric referral system, many birthing women (often without complications or known risk factors) bypass referring facilities to get access directly to the higher level of obstetric care. On the other hand, many women without access to care have to travel long distances to access care during labor and delivery. Difficulties related to referral health systems are frequently reported in sub-Saharan Africa [Cissé et al; 1998] and were common features in our hospital before 1994. Large population based studies emphasize the need to ensure that the women least likely to seek care are not marginalized [Jacqueline et al., 2003], requiring a functional referral system.

In Mali, access to cesarean delivery was a priority of referral system organisation from its inception. This system may be partially responsible for the decreased risk of caesarean-related maternal death after 1994 as well as the downward trend in post-cesarean stillbirth rates. However, the risk of maternal death when caesarean delivery is needed is still high despite adjustment for other factors. The unsatisfactory initial impact of cesarean delivery on maternal and fetal / neonatal health led the Malian government to make it free of charge. Many other countries engaged in such political commitment to eliminate financial barriers. However some authors reported that, although removing user fees has the potential to improve access to health services especially for the poor, it is not appropriate in all contexts [James et al, 2006]. Similarly, simulations have found that decreasing the price of Cesarean delivery has minor effects, suggesting that greater increases in access to care would come from investment in the improvement of healthcare structures and care processes [Mariko, 2003]. Developing countries face serious issues in this respect, due to the lack of and inequitable distribution of human resources. For example, in 2002 in Mali, 265 midwives were posted in Bamako or in regional hospitals, while only 164 were working at the

peripheral level. As a result, only 24% of deliveries were attended by a skilled professional. Similar figures have been reported from Tanzania [Olsen et al., 2005]. Many basic health facilities do not even have a midwife, so, many patients have to come directly to the tertiary hospital or go nowhere at all [Gerein N et al, 2006]. Many strategies have been or are being tested to solve this problem. Unfortunately, there is no one single-bullet solution [Dayrit et al, 2010]. These gaps contribute to the poor performance of the health system [Lawn J E., 2009]. Thus, a holistic approach has to be considered for better strengthening of the health system in order to meet the performance goals of the WHO schematic framework [WHO, 2007]

4.4 Cephalopelvic disproportion

The expression cephalopelvic disproportion (CPD) came into use prior to the 20th century to describe obstructed labor due to disparity between the dimensions of the fetal head and maternal pelvis that preclude vaginal delivery. This term, however, originated at a time when the main indication for cesarean delivery was overt pelvic contracture due to rickets (Olah & Neilson, 1994). CPD can be due to a contracted pelvis or a disproportionately large fetal head and is thus not limited to primary cesarean delivery only [Carbone B., 2000].

In a systematic review of cesarean delivery for maternal indication, Dumont A. et al [Dumont al, 2001] found that cephalopelvic disproportion was the commonest indication, and 1.4% to 8.5% of all deliveries resulted in cesarean birth for this indication. Similarly, a large population based study in West Africa reported that 1% of all deliveries were complicated by CPD [Ould El Jouda D et al, 2001]. The proportion of all cesarean deliveries due to contracted pelvis (a sub-entity of CPD) has been reported to be between 20% in Senegal [Bouillin et al, 1994] and 37.3% in Bobo Dioulasso, Burkina Faso [Bambara et al, 2007]. Comparable trends have been reported in Senegal with mean rates of 31.3% for CPD ranging from 26% to 34.9% between 1992 and 2001 [Cissé et al, 2004; N'Gom PM et al, 2004], as well as Ethiopia (34% [Fesseha et al, 2011]). Similar high incidence rates of CPD have been reported in non sub-Saharan developing countries [Festin et al, 2009]. Our data pointed out the importance of contracted pelvis in CPD. Cephalopelvic disproportion was a major indication of cesarean delivery in our hospital from 1985 to 2003. A mean rate of 39.6% of women who delivered abdominally had some degree of CPD, ranging from 30.3% to 43.4% between 1985 and 2003. In addition, in our study contracted pelvis constituted the vast majority of all CPD (87%). 63.5% of all contracted pelvis cases were found in patients referred most commonly from poor rural settings. The high incidence rates of uterine rupture (an end stage of obstructed labor) recorded in this group may correlate with severity of pelvis contraction and confirmed the close link between referred patients during labor / delivery and need of cesarean reported elsewhere [Amelink – Verburg et al, 2009].

The cause of high rates of contracted pelvis in rural areas may be due to several factors such as genetics, increasing recognition, or the impact of resource scarcity on the female bony pelvis [Cissé et al, 2004; Kurki, 2011]. Special attention must be devoted to malnutrition in sub-Saharan Africa. Malnutrition prevalence remains unfortunately high; the proportion of the population with low daily caloric intake exceed 30% in many countries, and this trend is mirrored by the prevalence of low weight in children under five years old [USAID / West Africa professional paper series, 2008]. Consequently, prevention of obstructed labor can be achieved only through a multidisciplinary approach aimed in the short term at identifying

high-risk cases and in the long term at improving nutrition. Early motherhood should be discouraged, and efforts are needed to improve nutrition during infancy, childhood, early adulthood, and pregnancy. Improving the access to and promoting the use of reproductive and contraceptive services will also help reduce the prevalence of this complication [Konje & Ladipo, 2000].

4.5 Previous cesarean delivery

One third of our patients with a history of previous cesarean delivery were allowed a trial of labor (TOL), and the probability of successful vaginal delivery in this group was 50.1%. In our guidelines for trial of labor after cesarean birth (TOLAC), neither labor induction nor labor augmentation were permitted. No TOLAC was attempted when the number of previous cesarean delivery was >1 or in the case of a previous history of uterine rupture. These strict criteria explained our relative low rate of TOLAC.

In a meta-analysis of 963 papers, the range for TOLAC and VBAC rates was large (28-82 percent and 49-87 percent, respectively). Predictors of women having a TOL were having a prior vaginal delivery and settings of higher-level care, namely tertiary care centers [Guise et al, 2010]. Similar findings have been reported in sub-Saharan [Boulvain et al, 1997]; the percentage of TOL ranged from 37% to 97% across reports, with probability of successful vaginal delivery of 69% (95% CI 63-75%). Maternal mortality among all women with a previous cesarean section was 1.9/1000 (95% CI 0-4.3). Uterine rupture and scar dehiscence occurred in 2.1% (95% CI 1.0-3.2). With our restrictions on VBAC, we recorded fewer vaginal deliveries, but also less uterine rupture / dehiscence, as was found in rural Zimbabwe [Spaans et al, 1997]. In settings where such cautions were not applied, higher morbidity levels were observed [Olagbuji et al., 2010, Adanu & McCarthy, 2007; Olusanya & Solanke, 2009; Sepou et al, 2003; Nwokoro et al 2003; Oboro et al, 2010; Wanyonyi & Karuga, 2010]. A large multicenter propective study in a western country with a uniform and well organised delivery care system emphasized the greater perinatal risk associated with a trial of labor [Landon et al, 2004]. Although these findings can be a subject of debate [Greene, 2004]; they must be considered and women deserve to be well informed of the risks and benefits of TOL and VBAC [Kraemer et al, 2004]. A recent systematic review suggests that VBAC is a reasonable choice for the majority of women and found that adverse outcomes were rare for both elective repeat cesarean delivery and trial of labor [Guise JM et al., 2010a, 2010b]. The need for studies identifying patients at greatest risk is of primary importance in sub-Saharan Africa where high levels of morbidity are often reported.

Overall, in sub-Saharan Africa a selective policy of trial of labor after a previous cesarean delivery has a success rate comparable to that observed in developed countries. Vaginal birth after cesarean appears to be relatively safe and applicable in this context and contributes significantly to the global cesarean delivery rate.

4.6 Low rates of elective delivery

There are many reports emphasising on the high levels of emergency delivery in sub-Saharan hospitals and health centres [Fesseha et al, 2011; Shah et al, 2009; Wylie & Mirza, 2008; Dumont et al, 2001]. In contrast to wealthier countries, planned delivery remains an underused option in Sub-Saharan Africa [Stavrou E. P. et al, 2011]. For example, during the

two decades at Point G teaching hospital, only 212 pregnant women underwent labor induction. In many sub-Saharan African countries, labor induction is not common as necessary medications are not readily available. Before the year 2000, oxytocine was the only medication available in Mali for labor induction and was only used for very favorable cases with a Bishop cervical score ≥ 7. Despite the lower rates of labor induction, we observe a mean rate of post-induction cesarean delivery of approximately 90% (Robson group 2). High levels of cesarean delivery following labor induction in nulliparas have been qualified as universal [Brennan et al, 2009 ; Main et al., 2006; McCarthy et al, 2007; Robson, 2001; Costa et al 2010; Yeast et al, 1999]

Unpublished data from the WHO Global Survey on Maternal and Perinatal Health, which included 373 health-care facilities in 24 countries and nearly 300 000 deliveries, showed that 9.6% of the deliveries involved labor induction. Overall, the survey found that facilities in African countries tended to have lower rates of induction of labor (lowest: Niger, 1.4%) compared with Asian and Latin American countries (highest: Sri Lanka, 35.5%) [WHO, 2010].

One point is that many indications of labor induction are associated with preterm delivery. The lack of neonatal resuscitation facilities [Hofmeyr et al, 2009] and the poor outcomes of preterm neonates lead many sub-saharan obstetric teams to avoid preterm labor induction or preterm elective cesarean delivery. Even in hospitals, staffs are frequently not trained in resuscitation and equipment is not available. A national service provision assessments in 6 African countries demonstrated that only 2%–12% of personnel conducting births had been trained in neonatal resuscitation and only 8%–22% of facilities had equipment for newborn respiratory support [Wall et al, 2009]. This important gap certainly impacts clinical decision making in Sub-Saharan obstetric units.

Therefore, it is a challenge for healthcare workers and policymakers dealing with pregnancy management in developing countries to examine critically ways to increase percentage of planned delivery. This challenge can be met firstly with preventive measures at a public health level (e.g. counselling and education), at the pregnant women's level (e.g. improved utilisation of the antenatal care services), and at the caregiver's level (e.g. better selection of cases in order improve the percentage of pregnant referred without emergency, an overt contracted pelvis mustn't begin labor at the level of primary care where obstetric surgery is not available).

5. Conclusion

From 1985 to 2003, cesarean delivery rates at Point G National Hospital increased substantially. Most of the increase in cesarean delivery rates is explained by higher proportions of outside referrals, cephalopelvic disproportion, and history of previous cesarean delivery. The increased cesarean delivery rate cannot, however, be fully explained by these factors or other characteristics collected by this study, and is likely the multifactorial impact of psychosocial determinants of healthcare utilization and systemic problems of healthcare delivery. These variables are beyond the scope of this study. Future ecological studies addressing clinical, financial, and geographical considerations as well as cultural acceptability of cesarean delivery are needed. Since emergency referrals for caesarean during delivery significantly worsen the maternal and fetal prognosis, more

widespread access to facilities capable of performing caesarean sections as well as earlier referrals of high risk pregnancies from primary health centers before the onset of complications would likely lead to substantial improvements in maternal and neonatal outcomes. A holistic need assessment will govern improved healthcare delivery strategies and aid progress towards meeting the millennium development goals in developing countries.

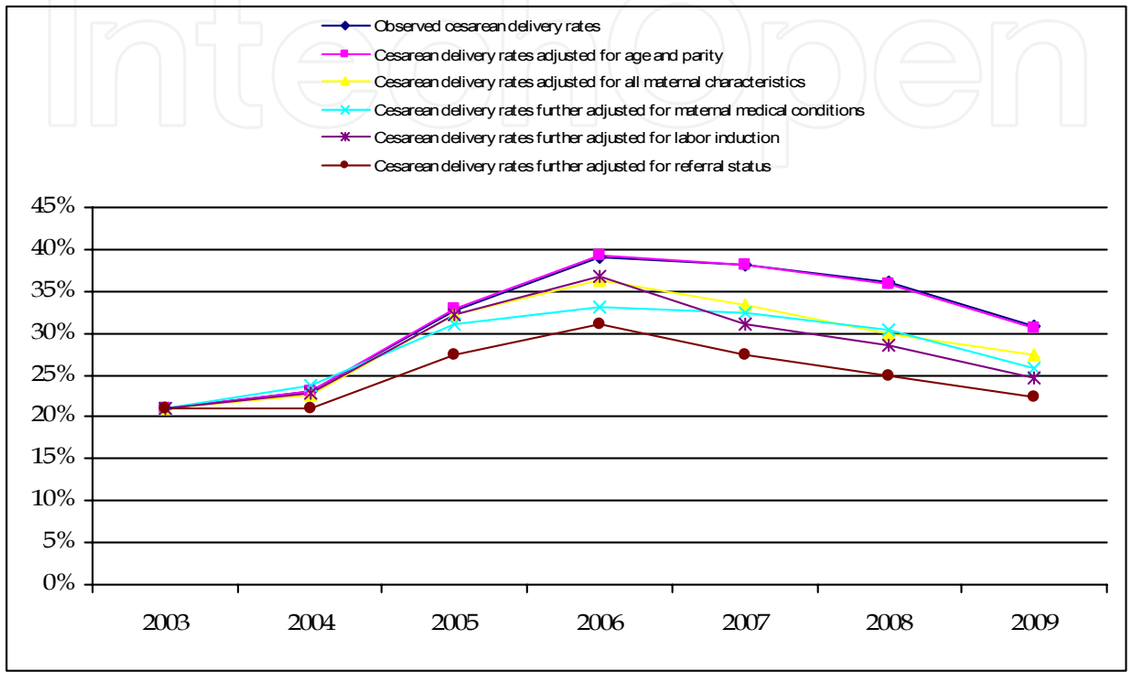

Fig. 9. Observed rates of cesarean delivery and adjusted rates after sequentially adjusting for age, parity, maternal conditions, obstetric practice and referral status (Teguete I. et al, 2010b).

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7. References

Adanu R.M.K. & McCarthy M.Y. (2007); Vaginal birth after cesarean delivery in the West African setting. *International Journal of Gynecology and Obstetrics* Vol .98, No 3, (September 2007), pp. (227–231). PMID: 17603060.

Althabe F, Belizán J, Villar J, Alexander S, Bergel E, Ramos S, Romero M, Donner A, Lindmark G, Langer A, Farnot U, Cecatti JG, Carroli G. & Kestler E. (2004). Latin American Cesarean Section Study Group: Mandatory second opinion to reduce

rates of unnecessary cesarean sections in Latin America: a cluster randomised controlled trial. *Lancet*, Vol 363, No 9425, (June 2004), pp. (1934-1940). PMID: 15194252.

Althabe F, Sosa C, Belizán JM, Gibbons L. & Jacquerioz F. (2006). Cesarean section rates and maternal and neonatal mortality in low-, medium-, and high-income countries: an ecological study. *Birth*, Vol. 33, No 4, (December 2006), pp. (270-277). PMID: 17150064.

Amelink-Verburg MP, Rijnders ME, Buitendijk SE. A trend analysis in referrals during pregnancy and labor in Dutch midwifery care 1988-2004. *BJOG*, Vol 116, No 7, (June 2009), pp. (923-32). PMID: 19522796

Andriamady Rasoarimahandry CL, Andrianarivony MO & Ranjalahy RJ. (2001). Indications and prognosis of cesarean section at Befelatanana maternity unit--Central University Hospital of Antananarivo (apropos of 529 cases, during the year 1998). *Gynecol Obstet Fertil*. Vol. 29, No 12, (December 2001), pp. (900-4). PMID : 11802553.

Ba K. S. (2011). Evaluation Finale de l'Initiative Vision 2010. Réunion d'Evaluation Finale de la VISION 2010 BAMAKO 1 - 6 Octobre 2011

Ba'aqeel H.S. (2009). Cesarean delivery rates in Saudi Arabia: A tenyear review. *Annals of Saudi Medicine* Vol. 29, No 3, (May - June 2009), pp. (179-183). PMID : 19448379.

Bambara M, Fongan E, Dao B, Ouattara H, Lankoande J. & Kone B. (2007). La césarienne en milieu africain: à propos de 440 cas à la maternité du CHUSS de Bobo-Dioulasso (Burkina Faso). *Méd Afrique Noire*, Vol. 54 No 6, (2007), pp. (343-348).

Barros FC, Vaughan JP, Victora CG & Huttly SRA. (1991). Epidemic of Cesarean sections in Brazil. *Lancet,* Vol 338, No 8760, (July 1991), pp. (167-169). PMID: 1677075.

Béla G., Péter N. & János T. (2009). Trends in prevalence of cesarean section in Uzsoki Hospital between 1st January, 1999 and 30th june, 2009. Analysis of some suspected factors. *Magyar Noorvosok Lapja* Vol. 72 No 6, (2009), pp. (269-272).

Belizán J. M., Althabe F., Barros F. C. & Alexander S. (1999). Rates and implications of cesarean sections in Latin America: ecological study. *BMJ* 1999; Vol. 319, No 7222, (November 1999) pp. (1397–402). PMID: 10574855.

Bell J, Curtis SL & Alayón S. (2003). Trends in delivery care in six countries. *DHS analytical studies* Calverton, MD: ORC Macro, No. 7, (2003), p. 62.

Betran AP, Merialdi M, Lauer JA, Bing-Shun W, Thomas J, Van Look P & Wagner M. (2007) Rates of cesarean section: analysis of global, regional and national estimates. *Paediat Perinatal Epidemiol* Vol. 21 No 2, (March 2007), pp. (98-113), PMID: 17302638.

Bogg L., Huang K., Long Q., Shen Y. & Hemminki E. (2010). Dramatic increase of Cesarean deliveries in the midst of health reforms in rural China. *Social Science & Medicine,* Vol. 70, No 10, (May 2010) pp. (1544–1549), PMID: 20219278.

Bouillin D, Fournier G, Gueye A, Diadhiou F & Cissé CT. (1994) Epidemiological surveillance and obstetrical dystocias surgery in Senegal. *Sante*, Vol. 4, No 6, (November – December 1994), pp. (399-406), PMID : 7850191.

Boulvain M, Fraser WD, Brisson-Carroll G, Faron G & Wollast E. (1997). Trial of labor after cesarean section in sub-Saharan Africa: a meta-analysis. *Br J Obstet Gynaecol.* Vol 104, No 12 (December 1997), pp. (1385-1390), PMID: 9422017.

Brennan DJ, Robson MS, Murphy M, et al. (2009). Comparative analysis of international cesarean delivery rates using 10-group classification identifies significant variation

in spontaneous labor. *Am J Obstet Gynecol* Vol. 201, No 3, (September 2009), pp. (308.e1-8), PMID:19733283.

Buekens P., Curtis S. & Alayón S. (2003) Demographic and Health Surveys: cesarean section rates in sub-Saharan Africa. *BMJ* Vol 326, No 7381, (January 2003), p. 136, PMID: 12531845.

Carbone B. (2000). Recommandations pour la pratique clinique. Indications de césarienne en cas de dystocie.*J Gynecol Obstet Biol Reprod*; Vol 29, No Suppl. n° 2, (2000), pp. (68 – 73).

Chaillet N, Dumont A. (2007). Evidence-Based Strategies for Reducing Cesarean Rates: A Meta Analysis. *Birth* Vol 34, No 1, (March 2007), pp. (53-64), PMID: 17324180.

Chou D. et al. (2010). Trends in Maternal Mortality: 1990 to 2008. World Health Organization: Geneva 2010.

Choudhury A.P., Dawson A.J. (2009). Trends in indications for cesarean sections over 7 years in a Welsh district general hospital. *Journal of Obstetrics and Gynaecology,* Vol 29, No 8, (November 2009), pp. (714-717), PMID: 19821664.

Cissé C.T., Faye E.O., de Bernis L., Dujardin B., Diadhiou F. (1998). Césariennes au Sénégal : couverture des besoins et qualité des services. *Cahiers Santé* Vol. 8, No 5, (September – October 1998), pp. (369-377) PMID : 98504015.

Cissé CT, Ngom PM, Guissé A, Faye EO, Moreau JC. (2004). Thinking about the evolution of cesarean section rate at University Teaching Hospital of Dakar between 1992 and 2001. *Gynecol Obstet Fertil.* Vol 32, No 3, (March 2004) pp. (210-217), 15123118.

Cohain J.S. (2009). Documented causes of unneCesareans. *Midwifery today with international midwife,* Vol. 63, No 92, (Winter 2009), pp. (18-19), PMID: 20092138.

Commission de l'Union Africaine. Réunion du Comité des experts de la troisième réunion conjointe en 2010 de la Conférence des ministres de l'économie et des finances de l'Union africaine et de la Conférence des ministres africains des finances, de la planification et du développement économique de la Commission économique pour l'Afrique. Rapport 2010 sur l'évaluation des progrès accomplis par l'Afrique vers la réalisation des Objectifs du Millénaire pour le développement. Lilongwe (Malawi) 25 –28 mars 2010.

Costa M. L., Cecatti J. G., Souza J. P., Milanez H. M. & Gülmezoglu A. M. (2010) Using a Cesarean Section Classification System based on characteristics of the population as a way of monitoring obstetric practice. *Reproductive Health* Vol 7, No 13, (June 2010), doi:10.1186/1742-4755-7-13 PMID: 20579388.

Cunningham FG, Gant NF, Leveno KJ, Gilstrap III LC, Hauth JC & Wenstrom KD. (2001). Williams Obstetrics. (21st Edition). McGraw-Hill, New York, 1668 p.

Dayrit MM, Dolea C. & Braichet JM. (2010). One piece of the puzzle to solve the human resources for health crisis. *Bull World Health Organ.* Vol. 88, No 5, (May 2010), p: 322 PMID : 20461216.

De Brouwere V. (1997). Appui à la mise en ouvre et à l'évaluation du système de référence avec la périnatalité comme porte d'entrée dans le Cercle. *UNICEF Mali*, 1997.

De Brouwere V, Dubourg D, Richard F. & Van Lerberghe W. (2002). Need for cesarean sections in west Africa. *The Lancet* Vol 359, No 9310 (March 2002) pp : 974 – 975, PMID : 11918936.

Dumont A., de Bernis L., Bouvier-Colle M-H & Bréart G, for the MOMA study group (2001). Cesarean section rate for maternal indication in sub-Saharan Africa: a systematic

review. *The Lancet*, Vol. 358, No 9290, (October 2001), pp. (1328–334), PMID: 11684214.

El-Khoury M, Gandaho T, Arur A, Keita B, & Nichols L. (2011). Improving Access to Life-saving Maternal

Health Services: The Effects of Removing User Fees for Cesareans in Mali. Bethesda, MD: *Health Systems 20/20*, April 2011, Abt Associates Inc.

Faundes A, Cecatti JG. (1993). Which policy for Cesarean section in Brazil? An analysis of trends and consequences. *Health Policy Plann* Vol. 8 No 1, (March 1993), pp. (33-42).

Fesseha N., Getachew A., Hiluf M., Gebrehiwot Y., Bailey P. (2011). A national review of cesarean delivery in Ethiopia. *International Journal of Gynecology and Obstetrics* Vol. 115, No 1, (October 2011) pp. (106–111), PMID: 21872239.

Festin MR, Laopaiboon M, Pattanittum P, Ewens MR, Henderson-Smart DJ, Crowther CA; SEA-ORCHID Study Group. (2009) Cesarean section in four South East Asian countries: reasons for, rates, associated care practices and health outcomes. *BMC Pregnancy Childbirth.* Vol. 9, No 9, (May 2009) p:17, PMID: 19426513.

Fournier P, Dumont A, Tourigny C, Dunkley G & Draméc S. (2009). Improved access to comprehensive emergency obstetric care and its effect on institutional maternal mortality in rural Mali. *Bull World Health Organ* Vol. 87, No 1, (January 2009), pp. (30–8), PMID: 19197402.

Geidam A.D., Audu B.M., Kawuwa B.M. & Obed J.Y.(2009) Rising trend and indications of cesarean section at the university of Maiduguri teaching hospital, Nigeria. *Annals of African Medicine*, Vol. 8, No 2, (April – June 2009) pp. (127-132). PMID: 19805945.

Gerein N, Green A, Pearson S. (2006). The implications of shortages of health professionals for maternal health in sub-Saharan Africa. *Reprod Health Matters* Vol. 14, No 27, (May 2006) pp. (40-50). PMID: 16713878.

Graham W. (1998). The scandal of the century. *Br J Obstet Gynaecol* Vol. 105, No 4, (April 1998), pp. (375-376). PMID: 9609258.

Greene M. (2004). Vaginal Birth After Cesarean Delivery Revisited. *New England Journal of Medicine* Vol. 351, No 25, (December 2004), pp. (2647-2649). PMID: 15598961.

Guihard P, Blondel B (2001).Trends in risk factors for cesarean sections in France between 1981 and 1995: lessons for reducing the rates in the future. *BJOG.* Vol. 108, No 1, (January 2001), pp. (48-55). PMID: 11213004.

Guise JM, Eden K, Emeis C, Denman MA, Marshall N, Fu RR, Janik R, Nygren P, Walker M, McDonagh M. (2010a). Vaginal birth after cesarean: new insights. *Evid Rep Technol Assess (Full Rep)*. No. 191, (March 2010), pp. (1-397). PMID : 20629481.

Guise JM, Denman MA, Emeis C, Marshall N, Walker M, Fu R, Janik R, Nygren P, Eden KB, McDonagh M. (2010b). Vaginal birth after cesarean: new insights on maternal and neonatal outcomes. *Obstet Gynecol.* Vol. 115, No 6, (June 2010), pp. (1267-78). PMID: 20502300.

Hofmeyr GJ, Haws RA., Bergström S, Lee ACC, Okong P, Darmstadt GL., Mullany LC., Shwe Oo EK, & Lawn JE. (2009). Obstetric care in low-resource settings: What, who, and how to overcome challenges to scale up? *International Journal of Gynecology and Obstetrics* Vol. 107, Suppl 1, (October 2009), pp. (S21–S45). PMID: 19815204.

Holtz SA & Stanton CK. (2007). Assessing the quality of cesarean birth data in the Demographic and Health Surveys. *Stud Fam Plann*. Vol 38, No 1, (March 2007); pp. (47-54). PMID: 17385382.

Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. (1992) CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. *Infect Control Hosp Epidemiol* Vol. 13, N°10: (October 1992), pp. (606-8). PMID: 1334988

Hosmer DW Jr, Lemeshow S. (1989). *Applied logistic regression*. pp. (131–3), John Wiley & Sons, New York.

Howell S., Johnston T., MacLeod S.-L. (2009) Trends and determinants of cesarean sections births in Queensland, 1997-2006. *Australian and New Zealand Journal of Obstetrics and Gynaecology* Vol. 49, No 6, (December 2009), pp. (606-611). PMID: 20070708.

Ijaiya M.A. and Aboyeji P.A. (2001). Cesarean delivery: the trend over a ten-year period at Ilorin, Nigeria. *The Nigerian Journal of Surgical Research*, Vol. 3, No 1 (March 2001), pp. (11 – 18).

Ikeako LC, Nwajiaku L, Ezegwui HU. (2009). Cesarean section in a secondary health hospital in Awka, Nigeria. *Niger Med J* Vol. 50, No…, (2009), pp. (64-67).

Jain N.J., Kruse L.K., Demissie K., Khandelwal M. (2009). Impact of mode of delivery on neonatal complications: Trends between 1997 and 2005. *Journal of Maternal-Fetal and Neonatal Medicine* Vol. 22, No 6, (June 2009), pp. (491-500). PMID: 19504405.

James C D., Hanson K, McPake B., Balabanova D., Gwatkin D., Hopwood I. Kirunga C., Knippenberg R.,

Meessen B., Morris S.l S., Preker A, Souteyrand Y., Tibouti A., Villeneuve P.l & Xu K. (2006). To Retain or Remove User Fees? Reflections on the Current Debate in Low- and Middle-Income Countries. *Appl Health Econ Health Policy* Vol. 5, No 3, (2006), pp. (137-153). PMID: 17132029.

Kandeh HB, Leigh B, Kanu MS et al. (1997). Community motivators promote use of emergency obstetric services in rural Sierra Leone. The Freetown/Makeni PMM Team. *International Journal of Gynaecology and Obstetrics* Vol. 59, Suppl 2, (November 1997), pp. (S209-18). PMID: 9389633.

Karlström A., Ra°destad I., Eriksson C., Rubertsson C., Nystedt A., and Hildingsson I. (2010). Cesarean Section without Medical Reason, 1997 to 2006: A Swedish Register Study. *Birth* Vol. 37, No 1, (March 2010), pp (11 – 20). PMID: 20402717.

Khawaja, M., Choueiry, N., Jurdi, R. (2009). Hospital-based cesarean section in the Arab region: An overview. *Eastern Mediterranean Health Journal*, Vol. 15, No 2, (March – April 2009), pp. (458-469). PMID : 19554995.

Khawaja M, Kabakian-Khasholian T, Jurdi R. (2004). Determinants of cesarean section in Egypt: evidence from the demographic and health survey. *Health Pol* Vol. 69, No 3, (September 2004), pp. (273-281). PMID: 15276307.

Kizonde K, Kinekinda X, Kimbala J, Kamwenyi K. (2006). La césarienne en milieu africain; exemple de la maternité centrale Sendwe de Lubumbashi, R. D. Congo. *Méd Afrique Noire* Vol. 53, No 5, (2006), pp. (293-298).

Klemetti, R., Che, X., Gao, Y., Raven, J., Wu, Z., Tang, S., Hemminki, E. (2010). Cesarean section delivery among primiparous women in rural China: an emerging epidemic. *American Journal of Obstetrics and Gynecology* Vol. 202, No 1, (January 2010), pp. (65.e1-65.e6). PMID: 19819416.

Konje J C and Ladipo O A. Nutrition and obstructed labor (2000). *Am J Clin Nutr* Vol 72, Suppl 1, (July 2000); pp. (291S–7S). PMID: 19871595.

Kowalewski A., Jahn A., Kimatta S.S. (2000). Why Do At-Risk Mothers Fail To Reach Referral Level? Barriers Beyond Distance and Cost. *Afr J Reprod Health,* Vol. 4, No 1, (2000), pp. (100-109).

Kraemer D. F., Berlin M., and Guise J-M. The relationship of health care delivery system characteristics and legal factors to mode of delivery in women with prior cesarean section: a systematic review. *Women's Health Issues* Vol. 14, No 3, (May – June 2004), pp. (94–103). PMID: 15193637.

Künzel W., Herrero J., Onwuhafua P., Staub T., Hornung C. (1996) Maternal and perinatal health in Mali, Togo and Nigeria. *European Journal of Obstetrics & Gynecology and Reproductive Biology,* Vol. 69, No 1, (1996) pp. (11-17). PMID: 8909951.

Kurki H.K. (2011). Compromised skeletal growth? Small body size and clinical contraction thresholds for the female pelvic canal. *Int. J. Paleopathol.* (2011), doi:10.1016/j.ijpp.2011.10.004

Kwawukume E. Y. (2001). Cesarean section in developing countries. *Best Practice & Research Clinical Obstetrics & Gynaecology*, Vol. 15, No. 1, (February 2001), pp. 165 – 178. PMID: 11359321.

Landon MB, Hauth JC, Leveno KJ, Spong CY, Leindecker S, Varner MW, et al. (2004). Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. *N Engl J Med*. Vol. 351, No 25, (December 2004), pp. (2581-9). PMID: 15598960.

Leone T., Padmadas S S., Matthews Z. (2008). Community factors affecting rising cesarean section rates in developing countries: An analysis of six countries. *Social Science & Medicine*, Vol 67, No 8, (October 2008) pp. (1236–1246). PMID: 18657345.

Mariko M. (2003). Quality of care and the demand for health services in Bamako, Mali: the specific roles of structural, process, and outcome components. *Social Science & Medicine* Vol. 56, No 6, (March 2003), pp. (1183–1196). PMID: 12600357.

Lawn J E., Kinney M, Lee A CC, Chopra M, Donnay F, Paul V. K., Bhutta Z A., Bateman M, Darmstadt G L. (2009). Reducing intrapartum-related deaths and disability: Can the health system deliver? *International Journal of Gynecology and Obstetrics* Vol. 107, Suppl. 1, (October 2009), pp. (S123–S142). PMID: 18815205.

Lawn J. E., Lee A. CC, Kinney M., Sibley L., Carlo W. A., Paul V. K., Pattinson R., Darmstadt G. L. (2009). Two million intrapartum-related stillbirths and neonatal deaths: Where, why, and what can be done? *International Journal of Gynecology and Obstetrics*, Vol. 107, Suppl. 1, (October 2009) ; pp. (S5–S19). PMID : 19815202.

Maiga Z, Traoré Nafo F & El Abassi A (1999) La réforme du secteur santé au Mali (1989-1996). *Studies in Health Services Organisation & Policy* 12. ITGPress, Antwerpen.

Main EK, Moore D, Farrell B, et al. (2006). Is there a useful cesarean birth measure? Assessment of the nulliparous term singleton vertex cesarean birth rate as a tool for obstetric quality improvement. *Am J Obstet Gynecol* Vol 194, No 6, (June 2006), pp. (1644-51), discussion (1651-2). PMID: 16643812.

Malvasi A., Tinelli A., Guido M., Zizza A., Cotrino G., Vergari U. (2009). The increasing trend in cesarean sections in south eastern italy: Medical and biopolitical analysis of causes and possible mechanisms for its reduction. *Current Women's Health Reviews* Vol. 5, No 3, (2009), pp. (176-183)

Mbaye EM, Dumont A, Ridde V, Briand V. (2011). Doing more to earn more: cesarean sections based on three cases of exemption from payment in Senegal. *Sante Publique*. Vol. 23, No 3, (May-June 2011), pp. (207-19). PMID: 21896215.

McCarthy FP, Rigg L, Cady L, Cullinane F. (2007). A new way of looking at Cesarean section births. *Aust N Z J Obstet Gynaecol* Vol 47, No 4, (August 2007), pp. (316-20). PMID: 17627688.

Menacker F, Declercq E, Macdorman MF. (2006). Cesarean delivery: background, trends, and epidemiology. *Semin Perinatol.* Vol. 30, No 5, (October 2006), pp. (235-41). PMID: 17011392.

Muganyizi P. S and Kidanto H. L. (2009). Impact of change in maternal age composition on the incidence of Cesarean section and low birth weight: analysis of delivery records at a tertiary hospital in Tanzania, 1999–2005. *BMC Pregnancy and Childbirth,* Vol. 9, (July 2009), p 30. PMID: 19622146.

Naidoo N., Moodley J. (2009). Rising rates of Cesarean sections: an audit of Cesarean sections in a specialist private practice. *SA Fam Pract* Vol. 51, No 3, (2009), pp. (254-258).

Ngom PM, Cisse CT, Cisse ML, Faye EO, Moreau JC. (2004). Epidemiology and prognosis of cesarean sections in University Hospital of Dakar. *Dakar Med.* Vol. 49, No 2, (2004), pp. (116-20). PMID: 15786620.

Nwakoby B, Akpala C, Nwagbo D et al. (1997). Community contact persons promote utilization of obstetric services, Anambra State, Nigeria. The Enugu PMM Team. *International Journal of Gynaecology and Obstetrics* Vol. 59, Suppl. 2, (November 1997), pp. (S219-24). PMID: 9389634.

Nwokoro C. A., Njokanma O. F., Orebamjo T., and Okeke G. C. E. (2003). Vaginal birth after primary cesarean section: the fetal size factor. *Journal of Obstetrics and Gynaecology,* Vol. 23, No. 4, (July 2003) pp. (392–393). PMID: 12881079.

Oboro V., Adewunmi A., Ande A, Olagbuji B., Ezeanochie M. & Oyeniran A. (2010). Morbidity associated with failed vaginal birth after cesarean section. *Acta Obstetricia et Gynecologica.* Vol. 89, No 9, (September 2010), pp. (1229–1232). PMID: 20804350.

Olagbuji B., Ezeanochie M.& Okonofua F. (2010). Predictors of successful vaginal delivery after previous cesarean section in a Nigerian tertiary hospital. *Journal of Obstetrics and Gynaecology*, Vol 30, No 6, (August 2010), pp. (582–585). PMID: 20701507.

Olah KSJ, Neilson J. (1994). Failure to progress in the management of labor. *Br J Obstet Gynaecol* Vol. 101, No 1, (January 1994), pp. (1 – 3). PMID: 8297861.

Olsen OE, Ndeki S, Norheim OF. (2005). Human resources for emergency obstetric care in northern Tanzania: distribution of quantity or quality? *Hum Resources Health* Vol. 3, No 5, (July 2005): 12 p. [Available from: www.human-resources-health.com/content/3/1/5] PMID: 16053519.

Olusanya B O., Solanke O A. (2009). Adverse neonatal outcomes associated with trial of labor after previous cesarean delivery in an inner-city hospital in Lagos, Nigeria. *International Journal of Gynecology and Obstetrics* Vol. 107, No 2, (November 2009), pp. (135–139). PMID: 19647823.

Onsrud L, Onsrud M. (1996). Increasing use of cesarean section, even in developing countries. *Tidsskr Nor Laegeforen* Vol. 116, No 1, (January 1996), pp. (67-71). PMID: 8553342.

Ould El Jouda D., Bouvier-Colle M.-H., MOMA Group. (2001). Dystocia: a study of its frequency and risk factors in seven cities of west Africa. *International Journal of Gynecology & Obstetrics* Vol 74, No 2 (August 2001), pp. (171 – 178). PMID: 11502297.

Riviere M. (1959). Mortalité maternelle au cours de l'état gravido-puerpéral, avortement exceptés. *Bull soc, gynécol Obstét., Congrés de Paris* No 11, (1959), pp. (141-272).

Robitail S, Gorde S, Barrau K, Tremouille S, Belec M. (2004). How much does a cesarean section cost in Madagascar? Socio-economical aspects and cesarean sections rate in Toamasina, Madagascar 1999-2001. *Bull Soc Pathol Exot.* Vol. 97, No 4, (November 2004), pp. (274-9). PMID: 17304751.

Robson MS. (2001). Classification of Cesarean Sections. *Fetal and Maternal Medicine Review* Vol 12, No 1, (January 2001), pp. (23-39).

Ronsmans C, Damme W V., Filippi V, Pittrof R. (2002). Need for cesarean sections in West Africa. *The Lancet* Vol 359, No 9310, (March 2002), p 974. PMID: 11861198.

Ronsmans C., Etard J. F., Walraven G., Høj L., Dumont A., de Bernis L. and Kodio B. Maternal mortality and access to obstetric services in West Africa. *Tropical Medicine and International Health*. Vol. 8, No 10, (October 2003), pp. (940–948). PMID: 14516306.

Rosenfield A, Maine D. (1985). Maternal mortality – a neglected tragedy. Where is the M in MCH? *Lancet* Vol. 2, No 8446, (July 1985), pp. (83-85). PMID: 2861534.

Rudge MV, Maesta I, Moura PM, Rudge CV, Morceli G, Costa RA, Abbade J, Peracoli JC, Witkin SS, Calderon IM,

Group C. (2011). The safe motherhood referral system to reduce cesarean sections and perinatal mortality - a cross-sectional study [1995-2006]. *Reprod Health.* Vol. 23, No 1, (November 2011), pp. (34). PMID: 22108042.

Samaké S, Traoré SM, Ba S, Dembélé É, Diop M, Mariko S, et al. (2007). Demography and Health SurveyMali 2006. Bamako: *Cellule de Planification et de Statistique, Ministère de la Santé* (2007).

Sepou A, Nguembi E, Yanza M-C, Penguélé A, Ngbalé R., Kouabosso A., Domandé-Modanga Z., Gaunefet C, Nali M. N. (2003) Utérus cicatriciel : suivi de 73 parturientes à la Maternité centrale de Bangui (République centrafricaine). *Cahiers d'études et de recherches francophones / Santé 2003*. Vol. 13, N. 4, (2003), pp. (231-3).

Shah A., Fawole B., M'Imunya J. M., Amokrane F., Nafiou I., Wolomby J-J., Mugerwa K., Neves I., Nguti R., Kublickas M., Mathai M. Cesarean delivery outcomes from the WHO global survey on maternal and perinatal health in Africa. *International Journal of Gynecology & Obstetrics*, Vol. 107, No 3, (December 2009), pp. (191-197). PMID: 19782977.

Sørbye I K, Vangen S, Oneko O, Sundby J and Bergsjø P. (2011). Cesarean section among referred and selfreferred birthing women: a cohort study from a tertiary hospital, northeastern Tanzania. *BMC Pregnancy and Childbirth* Vol. 11, No 55, (July 2011), PMID: 21798016. http://www.biomedcentral.com/1471-2393/11/55

Spaans W. A., van der Velde F. H., & van Roosmalen J. (1997). Trial of labor after previous cesarean section in rural Zimbabwe. *European Journal of Obstetrics & Gynecology and Reproductive Biology* Vol. 72, No 1, (March 1997), pp. (9 – 14). PMID: 9076415.

Stanton C.K., Dubourg D., De Brouwere, V., Pujades, M. & Ronsmans C. (2005). Reliability of data on cesarean sections in developing countries. *Bulletin of the World Health Organization* Vol 83, Vol 6, (June 2005), pp. (449-455). PMID: 15976896.

Stanton C., Ronsmans C., and the Baltimore Group on Cesarean. (2008). Recommendations for Routine Reporting on Indications for Cesarean Delivery in Developing Countries. *Birth* Vol. 35, No 3, (September 2008), pp. (204 – 2011). PMID: 18844646.

Stavrou E. P., Ford J. B., Shand A. W., Morris J. M., Roberts C. L. (2011). Epidemiology and trends for Cesarean section births in New South Wales, Australia: A population-based study. *BMC Pregnancy and Childbirth* Vol. 11, No 8, (January 2011). PMID: 21251270.

Stein W., Katundo I., Byengonzi B. (2008). Cesarean Rate and Uterine Rupture: A 15-year Hospital-Based Observational Retrospective Study in Rural Tanzania. *Z Geburtshilfe Neonatol* Vol. 212, No 6, (2008), pp. (222-225). PMID: 19085739.

Teguete I., Mounkoro N., Traore Y., Dolo T., Kayenta K., Diallo A., Sissoko A., Djire M., Traore M., Dolo A. Malaria and pregnancy at Gabriel Toure Teaching Hospital in Bamako between 2003 and 2007. *Journal de la SAGO*, Vol. 9, No 1, (2008), pp. (12-16).

Teguete I., Mounkoro N., Traore Y., Dolo T., Kayentao K., Sissoko A., Traore M., Dolo A. (2009). O928 Malaria and pregnancy at the Gabriel Toure teaching hospital in Bamako (Mali) between 2003 and 2007. *International Journal of Gynecology & Obstetrics*, Vol. 107, Suppl. 2, (October 2009), Page S357.

Teguete I., Traore Y., Dennis N., Mounkoro N., Traore M. and Dolo A. (2010). A 19-year retrospective investigation of maternal mortality at Point G National Hospital, Bamako, Mali. International Journal of Gynaecology and Obstetrics, Vol: 108, No 3, (March 2010), pp. (194 – 198). PMID: 19944419.

Teguete I, Mounkoro N, Traoré Y, Dolo T, Sissoko A, Djire MY Traoré M, Dolo A. Influencing factors of delivery rates at Gabriel Toure Teaching hospital, Bamako, Mali. Proceedings of the XIth African Society of Gynecology and Obstetrics (SAGO). Libreville (Gabon), November 22nd – 26th, 2010b. Abstract book, page 20.

UN. (1995). Report of the International Conference on Population and Development, (ICPD), Cairo, 5-13 September 1994, Programme of Action of the International Conference on Population and Development. *UN*, New York, 1995.

van Dillen J, Meguid T, Petrova V & van Roosmalen J.(2007) Cesarean section in a semi-rural hospital in northern Namibia. *BMC Pregnancy Childbirth* Vol 72, No 2, (March 2007), 6 p. [Available from: www.biomedcentral.com/1471-2393/7/2] PMID: 17346332.

Villar J, Valladares E, Wojdyla D, Zavaleta N, Carroli G, Velazco A, Shah A, Campodonico L, Bataglia V, Faundes A, Langer A, Narvaez A, Donner A, Romero M, Reynoso S, de Padua KS, Giordano D, Kublickas M, Acosta A, for the WHO 2005 global survey on maternal and perinatal health research group. (2006). Cesarean delivery rates and pregnancy outcomes: the 2005 WHO global survey on maternal and perinatal health in Latin America. *Lancet* Vol 367, No 9535, (2006), pp. (1819-29). PMID: 16753484.

Wall S. N., Lee A. CC., Niermeyer S., English M., Keenan W. J., Carlo W., Bhutta Z. A., Bang A., Narayanan I., Ariawan I. & Lawn J. E. (2009). Neonatal resuscitation in low-resource settings: What, who, and how to overcome challenges to scale up? *International Journal of Gynecology and Obstetrics* Vol. 107, Suppl. 1, (October 2009), pp. (S47–S64). PMID: 19815203.

Wanyonyi S. Z. & Karuga R. N. (2010). The utility of clinical care pathways in determining perinatal outcomes for women with one previous cesarean section; a retrospective service evaluation. *BMC Pregnancy and Childbirth,* Vol. 10, No 62, (October 2010), PMID: 20946628.

Wanyonyi S, Sequeira E, & Obura T. (2006). Caesarian section rates and perinatal outcome at the Aga Khan University Hospital, Nairobi. *East Afr Med J* Vol. 83, No 12, (December 2006), pp. (651-658). PMID: 17685209.

Weil O & Fernandez H. (1999). Is safe motherhood an orphan initiative? *Lancet,* Vol. 354, No 9182, (September 1999), pp. (940–43). PMID: 10489970.

Wenjuan W, Alva S., Wang S., & Fort A. (2011). Levels and Trends in the Use of Maternal Health Services in Developing Countries. *DHS Comparative Reports* 2011; No. 26. Calverton, Maryland, USA: ICF Macro.

West African regional food for peace office. (2008). Understanding Child Malnutrition in the Sahel: A Case Study from Goundam Cercle, Timbuktu Region, Mali. *USAID / West Africa professional paper series* N°6 (June 2008).

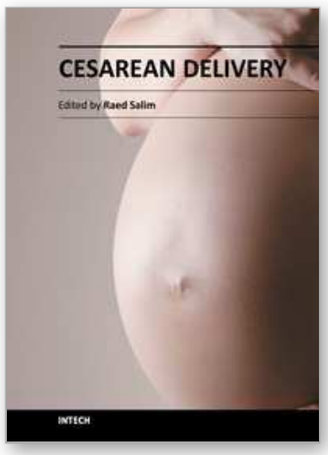
WHO (2010). Global Survey on Maternal and Perinatal Health. Induction of labor data. Geneva, World health Organization, 2010 (available at: http://www.who.int/reproductivehealth/topics/best_practices/global_survey)

World Health Organization. (2007). Everybody's business: Strengthening health systems to improve health outcomes. WHO's framework for action. *Geneva: WHO*; 2007

Wylie B. J. & Mirza F. G. (2008). Cesarean Delivery in the Developing World. *Clinics in Perinatology*, Vol. 35, No 3, (September 2008), pp. (571-582). PMID: 18952023.

Yeast J. D., Jones A., & Poskin M. (1999). Induction of labor and the relationship to cesarean delivery: A review of 7001 consecutive inductions. *Am J Obstet Gynecol,* Vol 180, No 3 Pt 1, (March 1999), pp. (628-33). PMID: 10076139.

Zhang J. & Yu KF. (1998). What's the relative risk? A method for correcting the odds ratio in cohort studies of common outcomes. *JAMA* Vol. 280, No 19, (November 1998), pp. (1690–1). PMID: 9832001.



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This book provides broad, science-based information regarding the most common major surgical procedure performed, i.e. Cesarean Delivery. The book provides relevant scientific literature regarding epidemiology and rates of cesarean delivery in low and high income countries and the impact of the disparities in the rate of cesarean delivery between countries. In addition, the book systematically reviews the relevant scientific literature regarding all perioperative considerations with a broad cover of anesthetic techniques, drugs and difficulties that anesthesiologists may encounter during cesarean delivery. Care of the neonate after cesarean and crucial guidelines for obese women undergoing cesarean are also provided. The book was written by distinguished experts from different disciplines to ensure complete and accurate coverage of the recent scientific and clinical advances and to bring care providers and purchasers up to date including essential information to help improve health care quality.

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