The Effect of Cesarean Delivery on Child Survival and Early Breastfeeding Practices: Global Data from 103 Provinces in the Eastern Mediterranean Region

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Abstract

Background: Early initiation of breastfeeding (EIBF) plays an important role in the reduction of infant mortality. Although delivery by cesarean section (CS) can save lives but delays EIBF and thereby increases risk of child mortality.

Aim: To examine the relationship between CS and EIBF with child mortality.

Methods: Data was recruited from recent demographic health surveys for 129 provinces of seven Eastern Mediterranean region (EMR) countries. Data for EBFI was available in 103 provinces. All data was analyzed for CS in relation to EIBF in first hour and first day, feeding prelacteals, delivery by skilled birth attendant (SBA), neonatal mortality (NMR), infant mortality (IMR) and under-five mortality rates (U5MR). The economic cost of unnecessary CS was analyzed. Statistical analysis was done using Pearson correlation and descriptive statistics.

Results: CS was inversely associated with EIBF in the first hour after birth (r-0.2, P=0.1), intake of prelacteals (r-0.3, P=0.008) and NMR (r-0.3, P=0.1), IMR (r-0.4, P=0.0001), and U5MR (r-0.4, P=0.0001) at P<0.05, and positively associated with EIBF in first day (r0.2, P=0.06). CS below the recommended level by WHO (<15%) was inversely associated with IMR. Moderately high CS >18%-38% was inversely correlated with EIBF and positively correlated with intake of prelacteals, NMR and IMR. Unnecessary CS and cumulative cost of CS was significantly correlated with U5MR, IMR and NMR (P<0.000).

Conclusions: Moderately high and especially unnecessary CS by unskilled birth attendant increase child mortality in the EMR. Efforts to increase breastfeeding initiation, as early as possible through skin-to-skin, with no prelacteals, may help alleviate the mortality rates from CS.

Key words: cesarean-section delivery, initiation of breastfeeding, neonatal mortality, infant mortality, prelacteal feeds.

Introduction

Researchers have shown that women who deliver by cesarean section (CS) are less likely to breastfeed, or delay breastfeeding initiation [1]. Breastfeeding within the first hour post-delivery has been cited as an important predictor of continued breastfeeding [2]. A longitudinal follow-up study of women in China who had a CS delivery showed a lower rate of exclusive breastfeeding (EBF) and any breastfeeding than those who had a vaginal delivery [3]. In addition, CS delivery was related with formula feeding in the hospital and delayed breastfeeding initiation [3] and this interferes with breastfeeding continuity [4]. However a study conducted in Egypt [5] showed that when women delivered by CS are supported in early breastfeeding initiation (EIBF) through skin-to-skin contact (SSC) for at least 20-30 minutes and follow-up support in breastfeeding, the continuity rates of breastfeeding were similar to those who underwent vaginal delivery.

Another study showed that women who were provided with support in early SSC were more likely to initiate and continue breastfeeding [6]. Furthermore EIBF with SSC has been shown to decrease neonatal and infant mortality [7].

However there is an argument of whether the 15% upper limit for CS, suggested by the World Health organization (WHO) in 1985, could be less valid nowadays taken into account changes of the population in high income countries, such as mother's age at the first child, birth-weight and other factors that may result in needing more or less CS. However, studies have shown that until now there is no evidence of benefit for the health of mothers and babies in populations with values of CS above 15% [8]. Regarding the lower limit, it has been argued that CS rates of 5% could achieve major improvement on maternal outcomes [9]. However, for neonatal health and survival, CS rates below 5% may be harmful, whereas CS rates between 5% and 10% have been reported to attain better outcomes [10, 11, 12].

We propose, as our null hypothesis, that the controversy of whether delivery by CS can influence child survival can be linked to EIBF. Since delay in breastfeeding initiation can increase mortality and CS can also influence mortality, it is not clear why CS can reduce child mortality in some instances but increases it in others. Suboptimal breastfeeding initiation, prelacteals, supplements given at birth, interference with first hour SSC may play a role in clarifying these controversies. Hence the aim of this study is to analyze country data from demographic surveys to achieve a better understanding of the underlying determinants that can improve poor outcomes of CS delivery and in the same time improve breastfeeding practices that can influence child survival in the Eastern Mediterranean region (EMR).

Methods
Data source: The data was assembled from the demographic health surveys (DHS) and Multiple Indicator Cluster Survey (MICS) and included data related to EIBF in the first hour and EIBF within the first day i.e. < 0-23 hours of life (EIBF< 24hrs), feeding prelacteals and skin to skin whenever recorded. Data about assistance at delivery included skilled birth attendant (SBA) at delivery, cesarean section delivery (CS) rates, and attendance of antenatal care (ANC) for over 4 times or any ANC in countries where the latter data was not available as in Yemen.

Countries and provinces: We studied data from demographic health surveys (DHS) of seven countries: Afghanistan in 2015[13], Egypt in 2014[14], Jordan 2017-18[15], Pakistan 2017-18[16], Sudan[17], Multiple Indicator Cluster Survey (MICS) of Somalia North East (NE) in 2011[18] and MICS of Somaliland in 2011[19] and finally Yemen in 2013[20]. The provinces (regions or governorates) included 33 in Afghanistan, 25 in Egypt, 12 in Jordan, 13 in Pakistan, 3 regions in Somalia NE and 5 regions in Somaliland, 18 in Sudan, 21 in Yemen, totaling 130. The provinces (regions or governorates) for each country included:

In Afghanistan (33): Kabul, Kapisa, Parwan, Wardak, Logar, Nangarhar , Laghman, Panjsher, Baghlan, Bamyan Ghazni , Paktika, Paktya, Khost, Kunarha, Nooristan, Badakhshan, Takhar, Kunduz, Samangan, Balkh, Sar-E-Pul , Ghor, Daykundi, Urozgan, Kandahar, Jawzjan, Faryab, Helmand, Badghis, Herat , Farah, and Nimroz.

Egypt governorates (25): Cairo, Alexandria, Port Said , Suez, Damietta, Dakahlia, Sharkia, Kalyubia, Kafr El-Sheikh, Gharbia, Menoufia, Behera, Ismailia, Giza, Beni Suef, Fayoum, Menya, Assuit, Souhag, Qena, Aswan, Luxor, Red Sea, New Valley and Matroh (North and South Sinai not included).

Jordan governorates (12): Amman, Balqa, Zarqa, Madaba, Irbid, Mafraq, Jarash, Ajloun, Karak, Tafiela, Ma'an, Aqaba.

Pakistan regions (12): Punjab (urban and rural), Sindh (urban and rural), Khyber Pakhtunkhwa (urban and rural), Balochistan (urban and rural) and ICT Islamabad and FATA, Azad Jammu and Kashmir (urban and rural) and Gilgit Baltistan,

Somalia regions (8): Somaliland included 5 regions: Maroodijeex/Saaxil, Awdal, Togdheer, Sool and Sanaag and Somalia NE included 3 regions: Bari, Nugal and Mudug.

Sudan governorates (18): Northern, River Nile, Red Sea, Kassala, Gadarif, Khartoum, Gezira, White Nile, Sinnar, Blue Nile, North Kordofan South Kordofan, West Kordofan, North Darfur, West Darfur, South Darfur, Central Darfur, East Darfur.

Yemen governorates (21): Ibb, Abyan, Sana'a City, Al-Baidha, Taiz, Al-Jawf, Hajjah, Al-Hodiedah, Hadramout, Dhamar, Shabwah, Sadah Sana'a, Aden, Lahj, Mareb, Al-Mhweit, Al-Mhrah, Amran, Aldhalae, Reimah.

The recent UNICEF MICS programme used similar modules to the DHS making comparisons possible. The surveys from which data was compiled were conducted by a national body and assisted by USAID and other donor agencies which provide assistance to the government. The data retrieved from the most recent national demographic surveys were compiled and analysed using statistical methods for analysis including the correlative studies using Pearson's correlative analysis. The cut off for statistical significance used was $P<0.05$.

Results

Table (1) presents the mean and standard deviation for the percent for EIBF in first hour and first day, prelacteal feeds, delivery by skilled health professionals, delivery by CS, NMR per thousand live births and IMR per thousand live births in the provinces of the seven countries. Mean % EIBF in the 1st hour and first day for all 101 provinces of six countries (Egypt excluded) was 55.9 ± 18.9 and 69.01 ± 20.9 respectively. Mean % EIBF 1st hour was highest in Jordan (63.9 ± 7.8) and lowest in Afghanistan (46.02 ± 17.9). Mean % EIBF 1st day was highest in Afghanistan (91.7 ± 7.2) and lowest in (46.02 ± 17.9). Mean % prelacteal feeds offered in 101 provinces in the region was 63.3 ± 26.5 being highest in Yemen 65.5 ± 12.5 and lowest in Sudan 27.4 ± 11.9 and Afghanistan 35.9 ± 19.1. Mean assistance at birth by skilled professional and CS rates was 57.25 ± 27.7 and 16.8 ± 20.3 respectively for 128 provinces (including Egypt). CS delivery was highest in Egypt 51.96 ± 13.3 and lowest in Afghanistan 2.1 ± 1.9, Somalia 2.4 ± 1.8 and Yemen 4.9 ± 3.3 this coincided with the percent of skilled birth attendant at birth. Mean NMR and IMR per 1000 live births in the 129 provinces were 24.9 ± 12.1 and 48.2 ± 26.5 respectively. NMR was highest in Somalia (40.8 ± 16.6), Pakistan (35.5 ± 9.7) and Sudan (31.8 ± 9.6) and lowest in Jordan (9 ± 3.3) and Egypt (16.6 ± 6.2). IMR was highest in Somalia (69 ± 19.9), Pakistan 54.5 ± 13.9 and Sudan (51.7 ± 16.1) and lowest in Jordan (14.2 ± 4.2) and Egypt (26.2 ± 9.2). There were apparant differences between LIC (63) including Afghanistan (33), Somalia (8) and Yemen (22), MIC (55) including Egypt (25), Sudan (18) and Pakistan (12) and HIC (12) except prelacteals and EBF in first hour.

Table (2) examines the correlations between ANC, delivery by SBA, CS with BFI and NMR, IMR U5MR at country level in seven countries. CS was inversely correlated with BFI<24 hours in Afghanistan (r-0.3), Jordan (r-0.5), and Pakistan. It was positively correlated with BFI<24 hours in Sudan (r0.7), but not correlated with BFI in Somalia and Yemen (P>0.05). CS correlated with intake of prelacteals in Sudan (r0.7) and Yemen (r0.5) and inversely in Afghanistan (r-0.3) but not in the other countries. CS correlated inversely with NMR, IMR and U5 MR in Egypt and Sudan but positively in Jordan but not or insignificantly so in other countries.

Delivery by SBA was not or inversely associated with EIBF in almost all the countries but ANC was negatively associated with EIBF in Afghanistan, Jordan and Pakistan but not in the remaining countries as shown in Table (2).

Table (3) presents the correlations between CS and other variables for all the 128 provinces for the seven countries under study. shows that CS was strongly associated with adequate ANC (>4times) and delivery by SBA and inversely correlated with NMR, IMR and U5MR at P<0.0001. ANC was associated with delivery by SBA and inversely correlated with mortality rates in early childhood at P<0.0001. Delivery by SBA was also strongly inversely correlated with NMR, IMR and U5MR in all the provinces of the seven countries under study irrespective of Cesarean rates.

Overall CS correlated inversely with mortality rates IMR (r-0.5), NMR (r-0.4) and U5MR (r-0.5) P<0.05 as shown in table (4). However table (5) demonstrates that the effect of CS on mortality vaired when cut-offs of CS rates were used. It presents the actual relationship between various cut offs of CS rates and BFI in first hour and first day, prelacteals given, delivery by skilled birth attendant, neonatal, infant and under-five mortality in the provinces of the 7 countries of the EMR.

CS cut off below 6% correlated significantly with EIBF in first hour (r0.6, P<0.01) and delivery by SBA (r0.3, P<0.01) but not with NMR, IMR or U5MR. CS cut off 6-17% was inversely correlated with BFI within 24 hours of birth (r0.8, P<0.01) and delivery by SBA (r-0.7, P<0.01) and positively with intake of

prelacteals (r0.65, P<0.01) but not with mortality rates. CS cut off >18% to 38% correlated inversely with ANC>4 times (r-0.7, P<0.01), delivery by SBA (r-0.9, P<0.01) and intake of prelacteals (r-0.6, P<0.01) but positively with IMR (r0.5, P<0.01) and U5MR (r0.6, P<0.01). CS above 40% were only reported in Egypt where EIBF at provincial level was not available but correlations between CS with ANC (r0.8, P<0.01) and SBA were significant (0.6 at P<0.01) and inversely with IMR (r-0.5) but not with NMR or U5MR (P>0.05).

Table (6) presents CS rates, number of unnecessary CS for the year 2008 cumulative cost in 13 countries of EMR and how this correlated with mortality rates in children, healthy life expectancy and early breastfeeding initiation. CS correlated with healthy life expectancy (r0.5) and inversely with NMR (r-0.2), IMR (r-0.2) and U5MR (r-0.4) but it was not statistically significant (P>0.05). Percent unnecessary CS correlated inversely with healthy life expectancy (r-0.4) but positively with NMR (r0.6), IMR (r0.6) and U5MR (r0.6) at P<0.05. Unnecessary CS, NMR, IMR and U5MR were highly correlated inversely with cumulative cost of CS at P<0.01. EIBF in first hour of birth was not correlated CS or percent unnecessary CS, but EIBF was not correlated with NMR (0.45) and IMR (0.37) and U5MR (r-0.4) P>0.05. The findings were not conclusive as the numbers were too small.

Figure (1) presents the type of birth attendant in each of the seven countries. In countries like Egypt and Jordan the physician was the predominant birth attendant. While in countries as Afghanistan, Pakistan, Somalia and Yemen the nurses, midwives and traditional birth attendants took the upper hand in delivery. In Sudan the predominant SBA were certified midwives. Mean CS delivery rate for each country was plotted against the SBA and was found to increase when majority of SBA were physicians.

Figure (2) shows that by socioeconomic status mortality rates and CS decreased by increasing wealth quintile, while EIBF and intake of prelacteals did not change much by level of wealth.

Table (6) and figure (3) compare the various variables under study in relation to level of education of the mothers in the provinces of the seven countries under study. There were significant decreases in ANC, CS and SBA and increases in NMR, IMR, U5MR in the poorer social classes. However early EIBF, SSC and prelacteals given at birth were not influenced by level of education.

Table (1) Comparison of mean rates of breastfeeding initiation, cesarean-section delivery, prelacteal feeding practices and mortality rates in 7 EMR countries at provincial level and by income country groups (low, middle and high income groups)

Country (# provinces)	EIBF 1st hr	EIBF <24 hrs	Prelacteal feeds offered	ANC>4 times	delivery by SBA	Delivery by CS	NMR/ 1000 LB	IMR/r 1000 LB	U5MR/ 1000 LB
Afghanistan (33)	46.02 ±18.2	91.7 ±7.3	35.9 ±19.4	56.65 ±22.02	46.85 ±20.8	2.1 ±1.9	26.0 ±12.6	48.6 ±23.8	58.6 ±30.86
Egypt (25)				83.29 ±8.99	92.5 ±7.33	51.9 ±13.6	16.36 ±6.5	25.36 ±9.66	25.6 ±19.3
Jordan (12)	63.9 ±8.1	80.5 ±5.4	40.4 ±5.5	92.2 ±3.08	99.7 ±0.24	25.1 ±5.1	9 ±3.4	14.2 ±4.4	16.5 ±4.1
Pakistan (12)	30.3** ±16.6	69.5 ±16.8	65.3 ±21.4	82.8 ±13.9	68.1 ±17.2	18.02 ±12.9	35.5 ±10.1	54.1 ±14.5	63.8 ±19.3
Somalia (8)*	61.5 ±5.01	86.1 ±3.4	44.86 ±4.8	12.56 ±5.7	38.09 ±12.8	2.8 ±2.4	40.8 ±9.8	69 ±18.6	89.2 ±223
Sudan (18)	67.6 ±12.4	87.1 ±5.8	27.4 ±12.2	50.4 ±11.9	75.8 ±18.5	6.2 ±5.9	31.8 ±9.9	51.7 ±16.5	69.5 ±22.4
Yemen (20)	55.1 ±10.1	78.7 ±8.7	65.5 ±12.8	25.45 ±12.4	47.4 ±18.8	4.9 ±3.4	25.9 ±5.5	44.6 ±11.9	54.1 ±14.8
	EIBF 1st hr	EIBF <24 hrs	Prelacteal feeds	ANC>4 times	delivery by SBA	CS	NMR/ 1000 LB	IMR/r 1000 LB	U5MR/ 1000 LB
LIC (59)	50.6 ±15.8	86.6 ±9.7	47.2 ±21.3	41.8 ±24.9	46.3 ±19.5	3.2 ±2.9	27.3 ±11.1	48.9 ±20.8	59.6 ±26.9
MIC (56)[2]	51.9 ±23.4	79.7 ±14.5	43.3 ±25.1	72.6 ±18.9	81.5 ±17.4	29.4 ±23.7	25.8 ±12.1	40.5 ±18.9	48.6 ±28.9
HIC (12)	63.9 ±8.2	80.5 ±5.4	40.4 ±5.5	92.2 ±3.1	99.7 ±0.25	25.1 ±5.1	9.0 ±3.4	14.2 ±4.4	16.6 ±4.1
Total	52.6 ±18.2	83.8 ±11.4	43.8 ±22.7	60.1 ±27.7	66.9 ±26.5	20.4 ±1.8	24.9 ±12.2	41.9 ±21.3	50.7 ±29.1

LIC: low income countries and include Afghanistan, Somalia, Sudan and Yemen, MIC: middle income countries and include Pakistan and Egypt, HIC: high income countries include Jordan. Mortality rates were calculated only for 5 provinces in Somaliland. EIBF: Breastfeeding initiation, CS: Cesarean section, NMR: neonatal mortality rate, IMR: infant mortality rate. [2] Egypt data for EBF and prelacteals excluded (31 cases analyzed instead of 56).

Table (2) Relationship between early breastfeeding practices and perinatal practices in the 102 provinces of the six regions under study[1]

		Antenatal care visits >4 (102)	Delivery by SBA (102)	Cesarean section (102)
Initiation of breastfeeding in the first hour of birth	Pearson Correlation	r0.147	r0.24*	r-0.2
	Sig. (2-tailed)	0.141	0.015	0.1
Initiation of breastfeeding in the first 24 hour of birth	Pearson Correlation	r-0.129	r0.25*	r0.2
	Sig. (2-tailed)	0.197	0.012	0.06
Prelacteals given at birth	Pearson Correlation	r0.018	r-0.4**	r-0.3**
	Sig. (2-tailed)	0.858	0.000	0.008

**. Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed). 1Data exclude Egypt governorates

Table (3) Correlations between antenatal care, delivery by skilled health professional, delivery by cesarean section with, breastfeeding initiation and neonatal, infant and under-five mortality rates

	EIBF 1st hr	EIBF <24 hr	Prelacteals given	NMR	IMR	U5MR
Afghanistan (33)						
Cesarean section	**r0.3**	**r-0.3**	**r-0.14**	**r-0.1**	**r-0.15**	**r-0.14**
Delivery by SBA	**r-0.2**	**r-0.1**	**r-0.2**	**r-0.3**	**r-0.4**	**r-0.5**
ANC >4 times	**r-0.07**	**r-0.001**	**r0.2**	**r-0.06**	**r-0.1**	**r-0.2**
Egypt (25)						
Cesarean section				**r-0.4**	**r-0.5***	**-r0.25**
Delivery by SBA				**r-0.26**	**r-0.4**	**r-0.4**
ANC >4 times				**r-0.3**	**r-0.43***	**r-0.4***
Jordan (12)						
Cesarean section	r-0.1	r-0.5	r0.2	r0.6	r0.6	r0.5
Delivery by SBA	r-0.4	r-0.17	r0.15	r-0.04	r-0.3	r-0.4
ANC >4 times	r-0.5	r-0.4	r0.4	r0.11	r0.07	r0.16
STS after birth	r0.9**	r0.63*	r-0.15	r0.13	r0.18	r0.4
Pakistan (12)						
Cesarean section	r-0.4	r-0.45	r0.16	r0.15	r-0.02	r-0.1
Delivery by SBA	r-0.5	r-0.3	r0.1	r0.003	r0.3	r-0.4
Any ANC	r-0.7*	r0.5	0.24	r0.04	r-0.3	r-0.33
STS after birth	r-0.5*	r-0.3	r-0.34	r-0.15	r-0.3	r-0.3
Somalia (8)						
Cesarean section	r0.2	r-0.3	r-0.3	r0.24	r0.14	r0.11
Delivery by SBA	r0.4	r0.17	r-0.3	r0.12	r0.005	r0.3
ANC >4 times (1)	r0.3	r-0.04	r-0.4	r-0.03	r0.02	r0.3
Sudan (18)						
Cesarean section	r0.54	r0.7	r0.6**	r-0.43	r-0.6**	r0.77**
Delivery by SBA	r0.3	r0.2	r0.001	r-0.11	r-0.03	r-0.001
ANC >4 times	r-0.04	r0.4	r0.4	r-0.3	r-0.3	r-0.4
Yemen (20)						
CS	r0.12	r0.04	r0.5	r-0.3	r-0.3	r-0.4
Delivery by SBA	r0.002	r0.07	r0.6**	r-0.4	r-0.5*	r-0.54*
Any ANC	r0.2	r0.01	r0.5*	r-0.3	r-0.5*	r-0.5*

P<0.05*, P<0.01**, ANC: antenatal care, SBA: skilled birth attendant (1) data for ANC only available for North East (3 provinces) and not Somaliland (5 provinces). 2. No data for Egypt governorates were available for EIBF and feeding prelacteals in secondary analysis.

Table (4) Relationship between Cesarean section and perinatal practices with mortality in children of the 129 provinces of the six countries under study

		CS (129)	ANC4 (129)	SBA (129)	NMR (129)	IMR (129)	U4MR (129)
Delivery by C-Section	Pearson Correlation	1	r0.620**	r0.702**	r-0.423**	r-0.507**	r-0.541**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
Antenatal care>4 times	Pearson Correlation	r0.620**	1	r0.654**	r-0.345**	r-0.407**	r-0.457**
	Sig. (2-tailed)	.000		.000	.000	.000	.000
Delivery by skilled birth attendant	Pearson Correlation	r0.702**	r0.654**	1	r-0.462**	r-0.597**	r-0.605**
	Sig. (2-tailed)	.000	.000		.000	.000	.000

**. Correlation is significant at the 0.01 level (2-tailed).

Figure (1) Type of birth attendant at delivery in each of the seven countries in relation to cesarean section

Legend: % Physician; Certified midwife; % Nurse/midwife or auxiliary nurse; % TBA or relative; CS

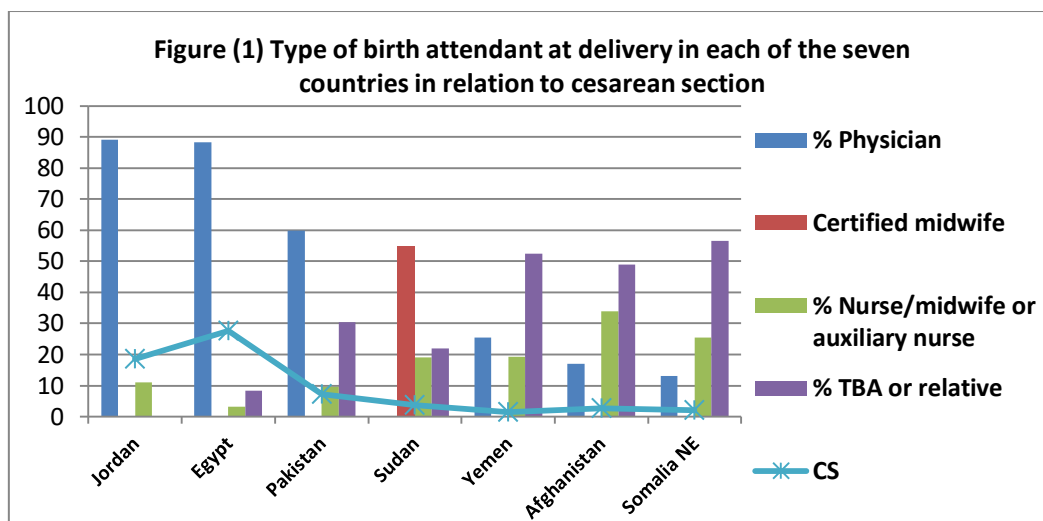Countries: Jordan, Egypt, Pakistan, Sudan, Yemen, Afghanistan, Somalia NE

Table (5) Relationship between cesarean section cut off rates and early breastfeeding initiation, prelacteals, skilled birth attendant, neonatal, infant and under-five mortality in the 128 provinces of the 7 countries of the EMR

Percent CS delivery rates	ANC>4	EIBF 1hr	EIBF<24hr	Prelacteals given	SBA	NMR	IMR	U5MR
CS <5 (61)	r-0.1	r-0.6**	r-0.2	r0.5**	r-0.3**	r-0.01	r0.06	r-0.06
CS 6-17 (23)	r-0.2	r0.04	r-0.8**	r0.65**	r-0.7**	r-0.2	r0.15	r0.1
CS 18- 38 (17)	r-0.7**	r-0.17	r-0.34	r-0.6**	r-0.9**	r0.34	r0.5*	r0.6**
CS > 40* (25)	r0.8**				r0.7**	r-0.4	r-0.5*	r-0.25

**. Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Table (6) Cesarean section rates, number of unnecessary cesarean sections for year 2008 in 13 countries of Eastern Mediterranean region cumulative cost and how this correlated with mortality rates in children, healthy life expectancy and breastfeeding initiation

	CS rate (%)	Unnecessary CS for year 2008			Healthy life expectancy	NMR	IMR	U5MR per 1000 live births	EIBF
Country		no	%	Cumulative cost					
Bahrain	16.0	140	0.0	100	67	1	5	6	
Iran	41.9	373,372	6.0	71.5	66.6	18	27	16	68.7
Egypt	27.6	253,890	4.1	75.6	64.1	13	20	24	27.1
Jordan	18.5	5,495	0.1	99.1	65	10	13	18	67
Lebanon	23.3	5,280	0.1	99.3	65.7	5	7	8	41.3
Libya	7.5	3,675	0.1	99.5	63.8	7	11	13	
Morocco	5.4	29,716	0.9	88.8	64.9	18	24	28	26.8
Pakistan	7.3	144,099	4.5	46.9	57.8	12	18	81	19.6
Qatar	15.9	135	0.0	100	67.7	4	7	7	33.5
Sudan	3.7	81,648	2.6	66.2	55.9	30	48	48	68.7
Tunisia	8.0	3,380	0.1	99.6	66.7	8	12	14	39.9
Oman	6.6	2,074	0.1	99.8	66.7	5	10	12	71.1
Yemen	1.4	72,756	2.3	68.5	57.7	22	34	42	52.7
Correlative studies with:									
	CS rates	-	% unnecessary CS	Cumulative cost	Healthy life expectancy	NMR	IMR	U5MR	EIBF
Healthy life Exp. (13)	r0.5	-	r-0.42	r0.78**		-	-	-	r0.00
NMR (13)	r-0.2	-	r0.57*	r-0.69**	r-0.74	-	-	-	r0.3
IMR (13)	r-0.2	-	r0.56*	r-0.69**	r-0.76**	-	-	-	0.3
U5MR (13)	r-0.4	-	r0.56*	r-0.9**	r-0.86**	-	-	-	r-0.3
EIBF 1st hr (11)	r0.11	-	r-0.05	r0.2	r0.001	r0.45	r0.37	r0.4	-

Figure (2) Relationships of early feeding practices with cesarean section and early child mortality rates by socioeconomic status in the 7 countries
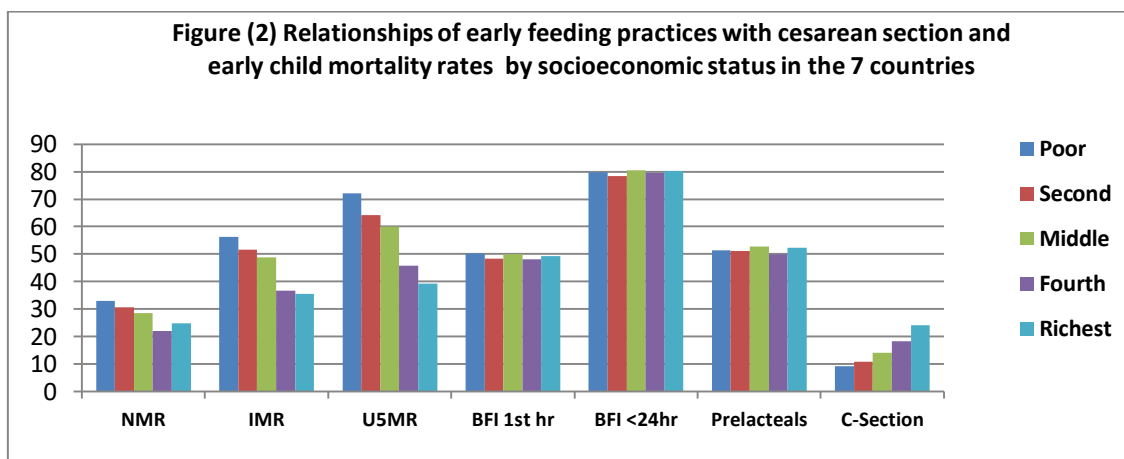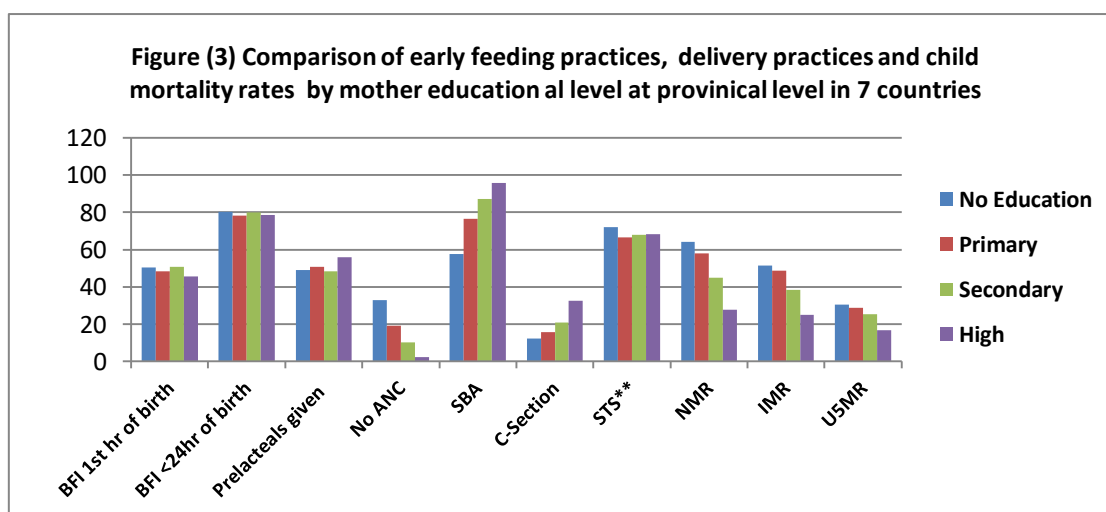
Table (7) Comparison of early feeding practices, delivery practices and early child mortality rates by level of education of mothers in the provinces of the seven EMR countries

Mean & SDS for:	No Education	Primary	Secondary*	High
EIBF 1st hr of birth	50.3±20.1	48.2±16.7	50.7±20.9	45.5±19.9
EIBF <24hr of birth	80.2±10.2	78.2±10.1	79.8±12.4	78.7±14.6
Prelacteals given	48.9±16.5	50.7±17.9	48.5±19.7	55.9±16.6
No ANC	32.8±18.8	19.1±13.03	10.1±6.6	2.4±2.4
SBA	57.6±21.4	76.4±14.0	87.01±9.4	95.7±3.5
C-Section	12.3±13.1	15.8±13.1	20.8±13.8	32.4±16.3
STS**	72.2	66.4	68	68.3
NMR	64.3±23.8	58.1±22.8	45.0±16.4	27.7±9.2
IMR	51.3±17.8	48.6±18.75	38.3±12.4	24.9±9.4
U5MR	30.4±11.8	28.6±12.2	25.2±9.6	16.9±7.06

EIBF: breastfeeding initiation, ANC: antenatal care, SBA: skilled birth attendant, C-section: cesarean section delivery, SSC: skin to skin care at birth, NMR: neonatal mortality rate per 1000 live birth, IMR: infant mortality rate per 1000 live birth, U5MR: Under-five mortality rate per 1000 live birth. Secondary also includes middle in a country as Pakistan* Skin to skin contact (SSC) at birth was reported only by Demographic survey in Jordan (2018).

Figure (3) Comparison of early feeding practices, delivery practices and child mortality rates by mother education al level at provincial level in 7 countries

Discussion

In this study we have used data from demographic health surveys (DHS). The DHS programme represents the largest worldwide effort to obtain nationally representative demographic and health data from household surveys in developing countries. Surveys are implemented by institutions in the host country, usually government statistical offices, and 5,000–30,000 women of childbearing age are interviewed in a standard survey. As the DHS use standardized questionnaires and methods of training, data collection and processing, they are often considered the 'best available gold standard' for many health indicators in developing

countries and are used for global monitoring efforts [21]. DHS figures are considered valid estimations of actual CS rates at country level, although they might be imprecise [22].

The mean CS was lowest in countries with low income as Afghanistan, Somalia and Yemen. It was highest in countries of high socioeconomic levels as in Jordan and lowest in Low income countries as Afghanistan and Yemen. CS varies in lower middle income countries, being very high in Egypt and moderately high with considerable variation between provinces in Pakistan and Sudan as per the World Bank classification. Betran et al. [10] also reported marked variations with CS births being 21.1% in developed countries, versus only 2% in developing countries with a worldwide average estimate of around 15%. In Latin America and the Caribbean it was highest at 29.2%, and in Africa it was lowest at 3.5% [10].

Our data showed that CS below 6% was somewhat inversely associated with IMR but poorly with NMR and U5MR. Although values from 6% to 17% were also inversely associated with IMR, it was not statistically significant. CS rates of 18 to 38 percent were positively associated with increased NMR, IMR and U5MR. CS over 40% was strongly associated with presence of SBA and CS but with no association with mortality. This shows that although the overall rates of CS appeared to be protective against child mortality, yet very high and very low had no effect. Moreover the cut offs in CS over the recommended by WHO demonstrate that CS there is a positive correlation with child mortality.

Also our analysis revealed a strong association between unnecessary CS and mortality rates in children and inverse correlations with healthy life expectancy in 13 countries of the EMR. The cumulative cost of unnecessary CS was inversely correlated with mortality and positively with life expectancy, this means that cost reduced from unnecessary CS by early mortality is significantly increased by health problems caused by CS later in life. Our findings are supported by those of Betran et al (2007) [10] and Athabe et al (2006) [11] who showed that in developing countries with low CS there is a strong inverse association between CS rates and maternal, infant and neonatal mortality suggesting that CS when indicated can reduce mortality. However they reported no association was observed in medium- and high-income countries for either neonatal mortality or maternal mortality [10,11]. Moreover CS is linked to gross chronic disorders as asthma, inflammatory bowel disease, diabetes mellitus, rheumatoid arthritis and leukemia probably due to altered microbiome that alters baby's immune system later in life [23]. Meta-analysis studies showed that exclusive breastfeeding (EBF) helps maintain micorbiome status and prevent dysbiosis that happens to infants born by CS and not EBF. The effect extends after six months in EBF [24]. Hence promoting early EIBF and EBF from birth can reduce morbidity and mortality from exposure to CS.

Although we did not find direct relationships between EIBF and CS at individual country level, overall there was a direct correlation between CS and EIBF rate in first hour when CS rate was <6 and an inverse relationship of EIBF at one hour and one day in regions when CS was between 18 to 38. This was also associated with a positive correlation between CS and NMR and IMR. At country level CS was inversely correlated with EIBF in the first 24 hours of life in Pakistan and Jordan indicating that CS may delay EIBF increasing the negative impact CS may have on child survival as shown by the positive correlation of CS with NMR in the provinces where CS ranged from 18 to 38 percent. Hobbs et al (2016) [1] reported that women who delivered by emergency CS were found to have a higher proportion of breastfeeding difficulties (41%), and used more resources before (67%) and after (58%) leaving the hospital, when compared to vaginal delivery or planned CS. Women who delivered with a planned CS were more likely to discontinue breastfeeding before 12 weeks postpartum compared to those who delivered vaginally. In this study we found that in high income countries (HICs) like Jordan when CS was performed before labour pains (i.e. planned CS) it was negatively correlated with EIBF. This was not the case for low income countries (LICs) like Sudan where planned CS and unplanned CS were both correlated with EIBF but also correlated with high intake of prelacteals. Hence the high EIBF, despite high intake of prelacteals was associated with the inverse associations between CS and child mortality (NMR and IMR) as in Sudan and Yemen. Hence CS and EIBF may work in synergy to save live births in LICs.

A review study [25] presented evidence that immediate or early skin-to-skin contact between mother and baby, after a CS may increase early EIBF, decrease time to the first breastfeed, reduce formula

supplementation in hospital, increase bonding and maternal satisfaction, maintain the temperature of newborns and reduce newborn stress. Similar findings were also reported by research workers in Egypt [5].

EIBF has been shown to be high in low and low middle income countries compared to HICs as Jordan. This can explain these differential findings between countries. Hence it is possible that delayed initiation of breastfeeding and offering prelacteal feeds may be confounding factors in influencing mortality rates associated with CS in such situations. Although Jordan had high EIBF rates, yet almost one half of newborns were offered prelacteals. Moreover antenatal care for over 4 times was inversely related with EIBF and positively correlated with NMR and IMR.

In this analysis EMR countries with highest CS were Iran (41.9%), Egypt (27.6%), Lebanon (23.3%) and Jordan (18.5%), while those with highest unnecessary CS rates were Iran (6%), Pakistan (4.5%) and Egypt (4.1%). Countries with highest cumulative cost from unnecessary CS were Bahrain, Lebanon, Libya Tunisia and Oman. The estimated cost of unnecessary CS, presented by the World Health Organization in 2010, report that countries of the EMR with CS over 15% total 209,707, 476 US dollars for the 13 EMR countries abstracted from their study [26]. The cost was inflated by healthy life expectancy and inversely related to early child mortality which increased by unnecessary CS.

In this study CS seemed to increase with increased socioeconomic status and level of education suggesting that CS high levels are primarily related to economic status and level of education. This has been shown by other researchers [10]. This raises the question of social inequality in the accessibility to CS delivery when needed to save lives vis. increased rates of unnecessary CS in the richer classes [27]. Other workers demonstrated that women in poor socioeconomic conditions had less access to CS in comparison with those women with low obstetric risk and high economic status [28] and higher education [29]. This paradoxical association of CS delivery with poverty explains why we found different correlations of CS with mortality at different cut-offs of CS. In contradistinction, other workers have shown that the rise in CS deliveries is justified in tertiary and quateriary referral hospitals where complicated cases that need CS exceed the WHO cut off of 15% [30]. Still such rates cannot explain the alarmingly high CS rates in countries as Egypt [14] and China [31] and many developed countries [32].

Poor access to CS was shown in some of the provinces in LICs with very low rates of CS <6 percent, and where mortality rates were high. Lack of access to skilled birth professionals and antenatal care are also possible confounders, as our analysis showed inverse correlations between ANC and SBA with mortality rates in Egypt, and Yemen for, but with SBA and not for ANC in Afghanistan and Sudan and for ANC but not SBA in Jordan. However there were insignificant correlations of SBA and ANC with mortality in Pakistan and Somalia. However SBA and ANC were inversely correlated with EIBF in Pakistan and Jordan and positively correlated with intake of prelacteals in Sudan and Yemen indicating a need for increasing the availability of SBA (midwives and obstetricians) in delivery and Baby-friendly practices in the countries of the region. Al-Jawaldeh and Abul-Fadl [33] have shown progress in making hospitals Baby-friendly in the EMR was slow particularly in the low and low middle income countries being halted by the political instabilities and ongoing conflict in these countries.

Cesarean delivery was influenced by the availability and type of SBA; as it increased where physicians were predominant decreased where midwives particularly certified midwives as in the case of Sudan were the predominant birth attendant. Research has shown that medical professionals tend to favour CS while midwives are more tolerant and supportive of natural childbirth and when trained can identify the high risk cases that need referral for operative delivery [34, 35]. Many countries in the region lack trained or certified midwives that can carry out normal deliveries. In Egypt with the disappearance of the "Dayas" as traditional birth attendants, most of the deliveries are carried out by medical professionals [36]. This explains the increasing CS in Jordan [37] and skyrocketing CS rates in Egypt increasing by 4.7 times in the private sector and 2.7 times in the public sector from 2005 to 2014 [38].

In conclusion the study shows that delivery by CS has a controversial role in influencing infant mortality [39, 40]. The socioeconomic status plays an important role especially in middle and low income groups [41, 42] whereas unnecessary CS is definitely associated with mortality especially when associated with poorly skilled health professionals and lack of early breastfeeding support. Early and exclusive breastfeeding

continue to have protective effects against the adverse effects on mortality and morbidity that can result from the increasing rates of CS, especially when unnecessary [43]. Caesarean birth is associated with short- and long-term risks that can extend many years beyond the current delivery and affect the health of women, children and future pregnancies and must be geared to the limited medical indications for saving lives without interfering with timely breastfeeding initiation [44]. Moreover, high rates of CS are associated with substantial health-care costs. Hence the World health organization (WHO) recommends that *health education for women is an essential component of antenatal care, implementation of evidence-based clinical practice guidelines with timely second opinion and collaborative midwifery-obstetrician model of care (i.e. a model of staffing based on care provided primarily by mid*wives [45]. Our study supports WHO recommendations and in particular with regards to training health professionals from the community as midwives and urging medical professionals attending births to encourage natural delivery and provide support for early initiation of breastfeeding through skin-to-skin and early and continued exclusive breastfeeding for the first six months of life, for healing the damage from operative delivery [46]. This can have positive effects on the economy of countries in the region and on reducing the burden of morbidity, mortality and chronic disorders from unnecessary CS and not breastfeeding.

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