Trends in the Prevalence and Determinants of Caesarean Section Delivery in Jordan: Evidence from Three Demographic and Health Surveys, 1990–2002

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Abstract

This paper explores recent levels and trends in the prevalence of Caesarean section (C-section) delivery in Jordan during the period 1990–2002 and examines the impact of socio-demographic, healthcare and spatial characteristics on C-sections there. The study used three national data sets from the Jordan Demographic and Health Survey (JDHS) program conducted in 1990, 1997 and 2002. The JDHS surveys were based on large, nationally representative samples of 16,296, 7335 and 7825 households. Rates of C-section delivery were calculated based on the last birth for each woman delivering in hospitals. Associations between C-section delivery and selected covariates were estimated using χ^2 tests and odds ratios from binary logistic regression models. Hospital-based C-sections increased consistently, from 8.5% in 1990, to 12.9% in 1997, to 17.8% in 2002. The rate of increase in C-section delivery was slightly higher in private hospitals than in public ones. Multiple births, child birth weight, old age at birth and antenatal visits were important determinants of C-section. Place of residence and place of delivery were not consistently associated with C-section. Unexpectedly, mother's education was also not associated with Caesarean section. The final model, based on the three merged data sets, showed a strong association between year of the survey and C-section, reflecting the substantial increase in C-section rates over time. Also, the odds ratio of C-section from multiple births was signifi-

cantly higher in 2002 compared with 1990. Halting the increase in C-section deliveries, especially in private hospitals, should become a priority for health professionals and policy makers in Jordan. Further in-depth studies are needed, however, to better monitor and analyze changes in C-section rates for identifying ways to reduce the prevalence of this surgical procedure.

Introduction

In recent years, Caesarean section (C-section) delivery has become increasingly common in developing countries (Dosa 2001; Lancet Editorial 2000; Stanton and Holtz 2006), owing largely to improved access to maternal health services. In many contexts, increased use of C-section is welcomed because the procedure can be life saving for mothers and their babies, reducing maternal mortality and ensuring a live birth without neurological complications (Shearer 1993). Ronsmans et al (2006) have recommended the use of this procedure as an indicator of maternal health, complementing skilled attendance rates, for the Millennium Development Goals. However, the recent rise of C-section delivery, especially in middle-income countries, has been widely debated (De Muylder 1993; Dosa 2001; Faundes and Cecatti 1993; Shearer 1993). Although sometimes necessary, C-section is not always medically indicated, and changes in the C-section delivery rate do not often correspond with mothers' medical risk profiles (Declercq et al 2006). Indeed, many countries have C-section rates exceeding the World Health Organization "threshold" (UNICEF, WHO, UNFPA 1997) of 15%, and prompting some to view the practice as an emerging global epidemic (Savage 2000). In addition to increased mortality and morbidity, the indiscriminate use of this surgical procedure may lead to women's discomfort after delivery, making it difficult for them to care for their newborns (Koc 2003).

Previous studies have identified various factors behind the worldwide increase in C-section delivery. First, advances in medical care made C-section delivery a fairly safe and easy procedure to perform, increasing the survival chances of the mother and newborn (Kumar 2006). Second, public campaigns and interventions to decrease maternal mortality may lead obstetricians to resort to C-section operations instead of normal delivery for difficult pregnancies. For example, some obstetricians automatically resort to this procedure instead of normal delivery for repeated C-section deliveries, despite the lack of evidence behind this practice. Third, the rapid decline of fertility during the past few decades has led couples and health policy makers to give greater attention to optimal pregnancy and infant outcomes (Sachs et al 1999). Fourth, demographic factors such as delayed age at marriage and hence advanced age at birth have became more important determinants of pregnancy outcomes during the course of fertility transition than before, increasing the pool of risky pregnancies. Fifth, convenience of delivery may figure prominently in some contexts, with obstetricians preferring to perform C-section operations in odd hours and weekends (De Muylder 1993; Dosa 2001). Sixth, the so-called defensive medicine, referring to obstetricians' fear of being sued for malpractice awards in case of pregnancy complications, may encourage clinicians to use C-section delivery (Dubay et al 1999; Murray 2000). Seventh, patient demand for this mode of delivery has increased, especially in some Latin American countries, due to, among other reasons, the belief that vaginal delivery is associated with future sexual dissatisfaction (Cotzias et al 2001; Minkoff et al 2004). Finally, with the increased availability of medical equipment, it may be more profitable for hospitals to do C-sections than natural childbirths. This may in turn lead to higher reimbursements for both physicians and hospitals. There is evidence that C-section deliveries are more common in private hospitals than in public ones (Khawaja et al 2004), and the gap between the private and public hospital C-section rates may be growing (Belizán et al 1999; Leung et al 2001; Padmadas et al 2000). Although women delivering by C-section in private hospitals tend to have different socio-economic and demographic characteristics than other women, C-section remains more common in private than in public hospitals after controlling for these characteristics (Khawaja et al 2004).

Limited research exists on levels and trends of Caesarean section delivery and their determinants for countries in the Middle East. Studies using population-based survey data are available only for

Egypt (Khawaja et al 2003; 2004) and Turkey (Koc 1999). Currently, Jordan has one of the highest C-section rates in the region; it has increased considerably since the early 1990s to 11.3% in 1996 (Jurdi and Khawaja 2004) and to nearly 18% in 2002. This paper examines recent levels and trends of Caesarean section rates and their determinants in Jordan, using comparable secondary survey data from three nationally representative samples of ever-married women aged 15–49. Survey data were comparable in that each survey used standardized instruments and similar sample designs and data collection procedures.

Materials and Methods

The study was based on three comparable data sets from the Jordan Demographic and Health Surveys (JDHS) conducted in 1990, 1997 and 2002. The Jordan Department of Statistics conducted the surveys in collaboration with Macro International. The JDHSs were based on nationally representative, random samples of 16,296, 7335 and 7825 households for 1990, 1997 and 2002, respectively. The three samples were stratified, and selected with probabilities proportional to estimated population size, using subsamples from master sampling frames maintained by the Department of Statistics. The sampling frame for the 1990 survey was based on estimated population size in 1989, and the last two surveys' sampling frames were based on the 1994 census of population and housing. All ever-married women aged 15–49 found in the selected households at the time of the surveys were eligible for interview. Face-to-face interviews with eligible respondents were carried out by trained female teams of interviewers, supervisors and data editors. Questionnaires were completed for 6461, 5548 and 6006 of those women, representing response rates of 89.2%, 96.2% and 97.6% for 1990, 1997 and 2002, respectively. Sampling design and data collection methodology used in the surveys have been described in detail elsewhere (Department of Statistics 1991, 1998, 2003). In each survey, women respondents were asked about the type of delivery, place of delivery, child birth weight and multiple births for their live births in the last 5 years preceding the survey. For example, in the 1997 survey, all women delivering a live birth between 1992 and 1997 were asked these delivery-related questions.

Because C-section in Jordan was performed only in hospitals, and in order to avoid over-representation of women who delivered more than once by C-section in the past 5 years, analyses were restricted to the last birth for each woman delivering in hospitals (Khawaja et al 2003; Mishra and Ramanathan 2002). According to Ronsmans et al (2006), including more than one birth to women delivering during a 3-year period may result in biased estimates, because women with short birth intervals tend to be poor. Limiting the analysis to the last birth also minimized possible recall problems, which are common in retrospective surveys, especially in developing countries (Cleland 1996). Restricting the analysis to the last birth in each survey reduced the size of the original samples considerably. The final samples consisted of 3585, 3446 and 3633 births from the 1990, 1997 and 2002 surveys.

The outcome variable of the study was the mode of delivery of last birth (1 = C-section; 0 = no C-section). A recent study showed that retrospective self-report data on this subject are valid and reliable (Stanton et al 2005). The main reason for this is that C-section delivery is a major surgical procedure that cannot be easily forgotten by women. Furthermore, the 5-year recall period for mode of delivery was short enough to prevent severe recall bias. Two variables indexing possible complications due to high-risk pregnancies were included as control variables: multiple births and birth weight. It is well known that twin births are more likely to undergo C-section than singleton births (Platt et al 2001). Here, we distinguished between singleton (0) and multiple births (1). Also, both very low and high birth weights were found to undergo C-section deliveries (Gomes et al 1999), so before analysis these were grouped into a "risk" category (1 = lowest to 2499 grams, and 4000 to highest grams) to distinguish them from "normal" (0 = 2500 to 3999 grams) birth weight.

Studies by Gomes et al (1999) and Ronsmans et al (2006) have indicated that the risk of undergoing a C-section depends on several non-medical factors. Hence, we included a set of socio-demographic, institutional and spatial measures as predictor variables.

Socio-demographic Variables

Age of mother at the time of childbirth is considered an important predictor variable for various reasons. Studies have shown that older mothers are more likely to have a C-section than younger mothers (Bell et al 2001; Peipert and Bracken 1993) because they are more likely to have bigger babies, thereby increasing the risk of complications during pregnancy and delivery (Mishra and Ramanathan 2002; Padmadas et al 2000; Webster 1992). Even in the absence of complications, some studies reported relatively high rates of C-section among older, especially primiparous, women (Khawaja et al 2004; Koc 2003; Peipert and Bracken 1993). Age of mother was therefore categorized into three groups (<20, 20–35 and >35 years), distinguishing high-risk age at birth (younger, teenage mothers and older mothers, aged >35) from low-risk ages (20–35 years). Mother's educational level (illiterate, primary, and secondary and above) was included as another predictor variable because educated women are more likely to delay motherhood, thereby increasing the potential for delivery by C-section (Padmadas et al 2000). Education is strongly associated with income, a variable known to influence health-service utilization, including emergency obstetric care.

Institutional Variables

The analysis included two institutional variables: antenatal care and place of delivery. Antenatal care was used to indicate greater utilization of services, perhaps due to high-risk pregnancies (Mishra and Ramanathan 2002; Padmadas et al 2000). It was measured by the number of antenatal care visits (0 = 0–6 visits; 1 = 7 or more visits). Place of delivery (1 = private, 0 = public hospital) was used because many studies reported a strong and positive association between delivering in private hospitals/clinics and C-section rates (Mishra and Ramanathan 2002; Padmadas et al 2000; Webster et al 1992). Reasons for this association include a selection effect in that near-birth complications induce women to seek better quality care in private hospitals rather than services provided at government hospitals. Other explanations include the greater availability of medical technology needed to carry out this surgical intervention in private than in public hospitals. Also, physicians in private hospitals may resort to using available technology for higher fees and hence profits.

Spatial Variables

A spatial variable, place of residence, was included in the analysis as it partly reflects differential access to healthcare facilities. Women residing in urban and socio-economically advantaged areas are more likely to have a C-section delivery than women living in disadvantaged rural communities (Mishra and Ramanathan 2002; Padmadas et al 2000; Ronsmans et al 2006).

For the first part of our analysis, we examined the characteristics of women delivering by C-section in 1990, 1997 and 2002. Our analysis was conducted using descriptive statistics and chi-square tests. Next, three multivariate binomial logistic regression models were run with the three groups of predictor variables (socio-demographic, institutional and spatial). We evaluated the associations using unadjusted and adjusted odds ratios in each of the three models. The adjusted odds ratios refer to the net effect of a given variable, controlling for the influence of all other variables included in the models. Finally, the three data sets were merged to test the time trends on C-section delivery in an inclusive regression model. All analyses were undertaken using the Stata 8.2 (2004) for MS Windows statistical program.

Results

Table 1 presents the sample characteristics of women and the proportions reporting C-section delivery by background variables for each survey year. While the indicators for high-risk pregnancies (multiple births and birth weight) remained relatively stable, the socio-demographic and institutional indicators changed over the years. The proportion of teenage mothers declined slightly, from 7.3% to 4.7%, and that of older mothers declined from 21.2% to 18.0%, during the 1990–2002 period. Significant changes were observed for education and antenatal care. The proportion of women with at least secondary education increased from 62.8% to 88.3%, with a corresponding

decrease in less-educated women. Similarly, the percentage of women making at least 7 antenatal-care visits increased substantially, from about 50% to 83%. The majority of women delivered in public hospital, but the proportion of women using private hospitals increased from about 30% to 35%. A similar change was observed for place of residence, the percentage of urban women increasing slightly from 74.6% in 1990 to 78.5% in 2002.

The hospital-based C-section rate increased from 8.5% in 1990 to12.9% in 1997 and to 17.8% in 2002. The C-section rate among women who had multiple births (22.2%) was significantly higher than for those who had singleton births (8.3%), (p = 0.003) in 1990. The rate for multiple births became much higher in 1990 (41.5%) and 2002 (60.0%), as compared with 12.4% and 16.9% for singleton births. The C-section rate was significantly higher among women who reported low (<2500 g) or heavy birth weights (>4000 g) (p = 0.000) compared with those with normal birth weights for all 3 survey years. The rate for high-risk pregnancies increased consistently over time from 12.5% in 1990 to 23.3% in 2002. The corresponding proportions for normal birth weights were 7.2% and 16.2%.

C-section rates for mothers aged 35 years or more increased from 12.6% in 1990 to 26.6% in 2002, and these are significantly higher than the corresponding rates for teenage mothers, 5.7% and 11.2%, respectively. For mother's education, there were small differences in the rates in any given year, increasing for all three educational groups. However, C-section was positively associated with the number of antenatal visits. The C-section rate for mothers who had seven or more antenatal visits increased from about 10% in 1990 to 18.7% in 2002, and the rates for those with six visits increased from 7.2% to 11.3%. The rate for deliveries in private hospitals nearly doubled during this period, increasing from 10.2% in 1990 to 20.2% in 2002, and were higher than those in public hospitals: 7.8% and 16.5%, respectively. Finally, C-section deliveries were more frequent in urban areas than in rural ones for the 3 survey years. It is interesting to note that the change in the rate was faster for rural areas, increasing from nearly 7% in 1990 to 17% in 2002, as compared with urban areas, where the rate doubled, increasing from about 9% to 18% during the same period.

Table 2 shows the odds ratios of C-section from logistic regressions for each survey separately. The table does not include education, because it was not statistically associated with C-section delivery at the bivariate level using a chi-square test (as reported in Table 1). The unadjusted odds ratios indicate that having multiple births, high-risk birth weight, older age at birth, seven or more antenatal-care visits, private hospital delivery and urban residence were all significant risk factors for C-section in the 3 survey years, with the exception of urban residence in 2002. The adjusted odds ratios remained highly significant for four variables, with place of delivery and residence being non-significant in 1990. The adjusted odds ratios for the remaining 2 years are fairly similar, with residence in 1997 and place of delivery in 2002 becoming statistically significant. In the 3 years, the strongest predictor of C-section was multiple births, the adjusted odds ratios for having multiple births increasing substantially from 2.72 in 1990 to 6.51 in 2002.

In order to uncover the effect of time period on the odds of having a C-section, the three data sets were merged before we computed the odds ratios from a combined regression model. As shown in Table 3, the odds ratios for all included covariates were statistically significant. The strong association between year and C-section reflects the substantial increase in C-section rates between 1990 and 2002. The adjusted odds ratios from Model 1 show that women were 2.17 times more likely to undertake a C-section in 2002 compared with 1990. With an odds ratio of 4.61, women having multiple births remained the strongest predictor of C-section delivery. Various interaction terms were included to explore possible interactions between the variables and time, but none of the terms was statistically significant, aside from multiple births. Model 2 shows the results of the combined model after including interaction terms for multiple births and year. The variable multiple births was statistically significant in the third time period (2002) compared with the first time period (1990) (OR = 2.36; p = 0.033). All other variables in the model retained their statistical significance after the addition of this interaction term. However, the odds ratio of the main effect of multiple births declined, but remained the largest at 2.7, in the final model.

Table 1. Sample characteristics and percent distribution of C-section by selected variables, Jordan, 1990–2002

Variable	1990			1997			2002		
	n	%	% C-section	*n*	%	% C-section	*n*	%	% C-section
Complications									
Multiple births									
No	3531	98.5	8.3	3393	98.4	12.4	3553	97.8	16.9
Yes	54	1.5	22.2	53	1.5	41.5	80	2.2	60.0
Child birth weight									
Normal	2672	74.5	7.2	2638	76.5	10.5	2801	77.1	16.2
High risk	913	25.5	12.5	807	23.4	20.4	832	22.9	23.3
Socio-demographic									
Mother's age									
<20	261	7.3	5.7	202	5.9	8.4	169	4.7	11.2
20–35	2565	71.5	7.6	2620	76.0	11.5	2810	77.3	16.2
>35	759	21.2	12.6	624	18.1	20.2	655	18.0	26.6
Mother's education									
Illiterate	587	16.4	11.1	191	5.5	11.5	135	3.7	21.5
Primary	748	20.9	9.6	414	12.0	15.2	291	8.0	22.7
Secondary+	2251	62.8	7.5	2841	82.4	12.6	3207	88.3	17.2
Institutional									
Antenatal care									
0–6	1803	50.3	7.2	1125	32.6	9.7	709	19.5	11.3
7+	1782	49.7	9.9	2321	67.3	14.4	3025	83.3	18.7
Place of delivery									
Public	2528	70.5	7.8	2099	60.9	11.9	2351	64.7	16.5
Private	1057	29.5	10.2	1347	39.1	14.4	1282	35.3	20.2
Spatial									
Region									
Rural	911	25.4	6.9	582	16.9	8.8	781	21.5	16.9
Urban	2674	74.6	9.1	2865	83.1	13.7	2852	78.5	18.1
Total	**3585**	**100.0**	**8.5**	**3447**	**100.0**	**12.9**	**3633**	**100.0**	**17.8**

Table 2. Logistic regression of the effects of selected characteristics on C-section, Jordan, 1990–2002

Variable	C-Section(1990)				C-Section(1997)				C-Section(2002)			
	Unadjusted OR	*P*-value	Adjusted OR	*P*-value	Unadjusted OR	*P*-value	Adjusted OR	*P*-value	Unadjusted OR	*P*-value	Adjusted OR	*P*-value
Complications												
Multiple births												
No	--		--		--		--		--		--	
Yes	3.13	0.001	2.72	0.003	4.98	0.000	4.23	0.000	7.28	0.000	6.51	0.000
Child birth weight												
Normal	1.00		1.00		1.00		1.00		1.00		--	
High risk	1.85	0.000	1.69	0.000	2.18	0.000	1.98	0.000	1.58	0.000	1.46	0.000
Socio-demographic												
Mother's age												
<20	--		--		--		--		--		--	
20–35	1.33	0.302	1.27	0.376	1.41	0.186	1.40	0.202	1.56	0.078	1.47	0.127
>35	2.34	0.003	2.24	0.005	2.78	0.000	2.68	0.000	2.92	0.000	2.84	0.000
Institutional												
Antenatal care visits												
0–6	--		--		--		--		--		--	
7+	1.43	0.003	1.41	0.006	1.56	0.000	1.51	0.001	1.74	0.000	1.60	0.000
Place of delivery												
Public	--		--		--		--		--		--	
Private	1.33	0.023	1.24	0.110	1.25	0.030	1.11	0.356	1.28	0.006	1.24	0.025
Spatial												
Region												
Rural	--		--		--		--		--		--	
Urban	1.34	0.044	1.26	0.138	1.66	0.001	1.56	0.007	0.93	0.466	1.04	0.763

OR = odds ratio.

Discussion and Conclusions

This study had the dual purpose of examining (1) recent trends in the prevalence of C-section and (2) changes in the determinants of C-section over time, using three nationally representative sample surveys conducted between 1990 and 2002 in Jordan. Results revealed a consistent increase in the prevalence rate of C-section from 8.5% in 1990 to 12.9% in 1997 and to 17.8% in 2002.

Findings from multivariate logistic regression showed that twin, child birth-weight, mother's age, antenatal care and place of delivery for both the second and third periods were important determinants of C-section. In order to examine the effect of time trend on rates of C-section adjusting for

other covariates, time of the survey was included in the final combined model as a covariate. The final model showed a substantial increase in the C-section rate over time, adjusting for all other covariates. Also in this model, the odds ratio for C-section from multiple births was significantly higher in 2002 compared with 1990.

Table 3. Combined logistic regression of the effects of selected characteristics on C-section, Jordan, 1990–2002

Variable	Unadjusted OR	P- value	Model 1		Model 2	
			Adjusted OR	*P*- value	Adjusted OR	*P*- value
Complications						
Multiple births						
No	--		--		--	
Yes	5.4	0.000	4.61	0.000	2.70	0.000
Child birth weight						
Normal	--		--		--	
High risk	1.78	0.000	1.68	0.000	1.68	0.000
Socio-demographic						
Mother's age						
<20	--		--		--	
20–35	1.54	0.004	1.40	0.030	1.39	0.030
>35	2.76	0.000	2.62	0.000	2.62	0.000
Institutional						
Antenatal care						
0–6	--		--		--	
7+	1.82	0.000	1.52	0.000	1.52	0.000
Place of delivery						
Public	--		--		--	
Private	1.32	0.000	1.20	0.005	1.19	0.005
Spatial						
Region						
Rural	--		--		--	
Urban	1.31	0.000	1.21	0.015	1.21	0.014
Trend						
Year						
1990	--		--		--	

Table 3. Continued

1997	1.58	0.000	1.49	0.000	1.46	0.000
2002	2.32	0.000	2.17	0.000	2.10	0.000
Multiple births * Year						
Multiple births * 1997	-	-	-	-	1.60	0.291
Multiple births * 2002	-	-	-	-	2.36	0.033

OR = odds ratio.

In general, this study clearly demonstrated a substantial increase in the prevalence of C-sections between 1990 and 2002 in Jordan. Although the appropriate C-section rate remains debatable (Lagrew and Adashek 1998), by 2002, Jordan had exceeded the recommended threshold of a population-based rate of 15% (Burns 1995). The increase in C-section rates was perhaps a reflection of improved access to maternal healthcare services. However, such an increase, and associated improvements in healthcare services, was uneven across socio-demographic and other characteristics.

In line with other studies (Khawaja et al 2004; Padmadas et al 2000; Signorelli et al 1995; Webster et al 1992), there was a positive association between the age of the mother at the time of childbirth and having a Caesarean section. This was an important result, since several delivery-related complications are associated with increased age. Moreover, older-age mothers, especially those more than 35 years, are more likely to have special situations due to being grand multiparas, having had a previous C-section or having had precious babies. These conditions are all considered very important indicators for undergoing a C-section.

Except for the second period survey (1997), there was no significant difference in C-section rates between urban and rural dwellings in Jordan. The reason could be that the boundaries between urban and rural are not well demarcated, with the majority of people who live in rural settings travelling and working in big cities. Furthermore, the connectedness of the country and the availability and affordability of health services both in rural and urban areas may be a suitable interpretation of this finding. In Jordan, almost all women deliver in hospitals, and home delivery is a very rare event. The incidence of twin births is increasing in many countries (Meredith et al 2003; WHO 1985), and consequently, the prevalence of C-section related to twin births also increased, since twins are usually associated with complications during pregnancy and around delivery, and are one of the relevant clinical indicators for C-section.

Consistent with previous studies, extreme birth weight is another determinant of Caesarean section. Both large and small births are associated with complicated pregnancies and were more likely to be delivered by C-section. The positive association between C-section and the number of antenatal care visits has been described before (Khawaja et al 2004). It is important to mention that all maternal and child healthcare services are free of charge in Jordan. This allows healthcare providers to capture the high-risk group of pregnant women and to continue to follow them until birth, enabling the establishment of an appropriate diagnosis. The association between age and education could be one of the reasons behind the lack of significant association between education and C-section, since more educated women tend to delay the time of pregnancy (Mishra and Ramanathan 2002).

Place of delivery (public/private hospital) was not a significant determinant of C-section in 1992 and 1997, but it became so in 2002. Recently, the private sector has grown rapidly in Jordan. Furthermore, and as a result of privatization, the insurance companies contract for care of their beneficiaries in private hospitals and thus access is not restricted to women from a high socio-economic class. Moreover, the profitability of the private hospital may also play a role in this situa-

tion, in addition to the public's perception that medical services in the private sector are better than public ones. Studies have shown that physicians' predisposition can also be an important determinant of the C-section (Gomes et al 1995; Padmadas et al 2000; Platt et al 2001); obstetricians may perform C-sections to manage their time (Padmadas et al 2000).

The main strength of this study was its use of data from three large population-based surveys from a middle-income country in the Middle East, enabling us to analyze trends of C-section delivery over time. The study had some limitations, however. First, our analyses were restricted to the last birth, and thus previous histories of C-section delivery were not included in the analysis. We know from other studies that repeat C-section is rather common, and hence previous history of C-section delivery is an important predictor of future delivery (Githerns et al 1993). Furthermore, the lack of these data prevented us from determining the primary Caesarean rate. Second, all data used in this study were self-reported, with associated problems of validity and social desirability during interviewing. Although the Demographic and Health Survey program implemented rigorous training for interviewers, and interviews were subjected to careful supervision and spot-checking to ensure validity and confidentiality of responses during fieldwork, we have no means to validate the self-reported responses. Various cross-checks with birth history data were performed to validate the responses on the last births, but the data could not be verified by facility-based medical records. We do, however, believe that self-reports of pregnancy-related items, such as mode of delivery, are usually reliable and valid (Githerns et al 1993; Stanton et al 2005).

Third, unlike other countries where the Demographic and Health Surveys were conducted, in Jordan, questions about near-birth complications were not included in any of the three surveys. We did not know, for example, if C-section was elective or not. Nor did we have data on major conditions associated with C-section delivery such as fetal distress. Finally, although we had information about mother's education and place of residence, data on household income were lacking in these surveys owing to the sensitivity of these questions in this particular context.

In conclusion, this study detected an increased trend of C-section rates in Jordan, and the rate exceeds limits recommended by the WHO. The excess in C-section rates suggests there may be some non-medical predictors of this surgical procedure. Studies to further explore these determinants are urgently needed in order to avoid unnecessary C-section, as such increases in rates may have serious economic consequences for the Jordanian health sector. Indiscriminate use of surgical procedures in delivery may increase morbidity, mortality and women's discomfort after birth, with clear consequences for the care and well-being of their children. Halting the increase in C-section deliveries should therefore become a priority for health professionals, reproductive health programs, and policy makers in Jordan. As the private sector of the Jordanian healthcare system has been growing, monitoring the prevalence of C-section deliveries, particularly in private hospitals, will be necessary. Also, many hospitals in Jordan, as elsewhere in the region, do not currently have written policy guidelines for the performance of C-section deliveries. Policies to halt the growing rates of C-section in Jordan can be enforced, including the conduct of vaginal births after C-section deliveries, labour induction and augmentation, and securing a second opinion to initiate a C-section. Such policies should be formulated and enacted if we are to prevent further increases in C-section deliveries and improve the overall quality of reproductive healthcare for mothers and their babies.

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