DOI: 10.1111/j.1471-0528.2009.02348.x
www.bjog.org

Factors and outcomes associated with the induction of labour in Latin America

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Accepted 18 July 2009.

Objective To describe the prevalence of labour induction, together with its risk factors and outcomes in Latin America.

Design Analysis of the 2005 WHO global survey database.

Setting Eight selected Latin American countries.

Population All women who gave birth during the study period in 120 participating institutions.

Methods Bivariate and multivariate analyses.

Main outcome measures Indications for labour induction per country, success rate per method, risk factors for induction, and maternal and perinatal outcomes.

Results Of the 97 095 deliveries included in the survey, 11 077 (11.4%) were induced, with 74.2% occurring in public institutions, 20.9% in social security hospitals and 4.9% in private institutions. Induction rates ranged from 5.1% in Peru to 20.1% in Cuba. The main indications were premature rupture of membranes (25.3%) and elective induction (28.9%). The success rate of vaginal delivery was very similar for oxytocin (69.9%) and misoprostol (74.8%), with an overall success rate of 70.4%. Induced labour was more common in women over 35 years of age. Maternal complications included higher rates of perineal laceration, need for uterotonic agents, hysterectomy, ICU admission, hospital stay >7 days and increased need for anaesthetic/analgesic procedures. Some adverse perinatal outcomes were also higher: low 5-minute Apgar score, very low birthweight, admission to neonatal ICU and delayed initiation of breastfeeding.

Conclusions In Latin America, labour was induced in slightly more than 10% of deliveries; success rates were high irrespective of the method used. Induced labour is, however, associated with poorer maternal and perinatal outcomes than spontaneous labour.

Keywords Labour induction, mode of delivery, perinatal outcome, pregnancy complications.

Please cite this paper as: Guerra G, Cecatti J, Souza J, Faúndes A, Morais S, Gülmezoglu A, Parpinelli M, Passini R, Carroli G for the World Health Organisation 2005 Global Survey on Maternal and Perinatal Health Research Group. Factors and outcomes associated with the induction of labour in Latin America. BJOG 2009;116:1762–1772.

Introduction

Despite the undisputed importance of labour induction for ending pregnancies in which there is a risk to the mother or fetus, this intervention may result in undesirable effects. It should therefore only be indicated when the benefits to the mother and the fetus surpass the risks of waiting for spontaneous onset of labour.[1] Worldwide, the prevalence of labour induction varies greatly between countries and even between different regions of the same country. In general, however, it is higher in developed countries (at around 20%) than in developing countries.[1–6]

The indications established by specialist societies and by various other authors are generally the same: hypertensive disorders of pregnancy, post-term pregnancy, premature rupture of membranes, chorioamnionitis, diabetes, intrauterine growth restriction, isoimmunisation, fetal death and other maternal conditions. In addition, the procedure may sometimes be performed on request by the woman (elective induction).[1,3,6,7]

Labour induction represents an attempt to reduce the prevalence rate of caesarean sections, whose rates are increasing worldwide.[4,8] It has been suggested that regions

with high rates of induced labour generally have lower rates of caesarean section.[3,9] Several studies have related an increase in neonatal morbidity and mortality with elective caesarean sections, and this increase also reflects on child mortality rates.[8,10–14]

There is a consensus that the success of induced labour is directly related to the status of the cervix, with higher caesarean section rates in those with an unfavourable cervix. In addition to an unfavourable cervix, other factors that contribute towards increasing the risks of a caesarean section following labour induction include nulliparity, obesity, mother's age above 30 years, fetal macrosomia, use of epidural anaesthesia, use of magnesium sulphate and chorioamnionitis.[15–17] Inducing labour in nulliparas also increases the risk of instrumental vaginal delivery,[18] blood transfusion, longer hospital stay,[17] need for immediate care for the newborn infant and its admission to an intensive care unit.[17,18] Nevertheless, Yeast *et al.*[3] justify these perinatal results as being related to the very pathological conditions that lead to an indication for induction.

It is well-known that the risk of fetal death increases in post-term pregnancies. Labour induction after 41 completed weeks of pregnancy should therefore prevent fetal or neonatal death.[19,20] Nevertheless, the absolute risk is very low and it is thought that from 41 weeks onwards the pregnant woman who has no other complications should be able to choose whether to undergo immediate induction or await spontaneous labour. In the latter group, fetal vitality is monitored up to a maximum of 42 weeks, after which time labour should be induced.[20,21]

Since induced labour involves medical interventions, it increases hospital costs and should therefore be restricted to medically indicated cases.[22] However, when properly indicated, the procedure should also reduce the need for caesarean section, a procedure that is known to increase maternal and neonatal morbidity and mortality. In Latin America, the rate of labour induction is one of the least known population obstetric statistics. But knowledge of the determinants of labour induction may be a useful tool for monitoring the frequency and place of induction, as well as whether it is being overused or underused. The objective of the present study was to evaluate the prevalence of labour induction, the factors associated with this practice, and maternal and perinatal outcome in hospitals in selected countries of Latin America that participated in the Global Survey project.

Methods

The study protocol and methods have already been described in detail.[8,23] A secondary analysis was performed on the database from the international multicentre study '2005 World Health Organisation (WHO) Global Survey for Maternal and Perinatal Health' (Project A25176) to evaluate the prevalence of induced labour, associated factors and maternal and perinatal outcomes in eight countries of Latin America. The maternal mortality ratios in the eight countries were 240 maternal deaths per 100 000 live births for Peru, 210 for Ecuador, 170 for Nicaragua, 150 for Paraguay, 132 for the Latin America and the Caribbean, 110 for Brazil, 77 for Argentina, 60 for Mexico and 45 for Cuba.[24] Of a total of 410 healthcare institutions, 122 were randomly selected and 120 of these participated in the study.[8,23]

In the selected countries, the capital city and two randomly selected geographical areas (a state or province) were selected with probability proportionate to the population. Up to seven institutions with 1000 births or more per year were selected in each state or province. The length of the data collection period was for 3 months if the number of deliveries was ≤6000/year and 2 months if the number of deliveries exceeded 6000/year. Individual data from the women and their newborn infants were obtained from the medical charts of all the women who gave birth during the study period, which ranged from September 2004 to March 2005.[8,23] The data were entered onto a standard case report immediately after the woman's discharge from the hospital, with data taken from the patients' case notes. Any inconsistency in the data was corrected by the co-ordinator of the project in the hospital by reviewing the charts and by discussion with physicians responsible for the mother and her infant prior to discharging them from hospital. Only after completion of this procedure were the data inserted directly into the computerised study database by single data entry.

Each institution received the approval of their Institutional Review Board or from the National Ethics Committee when there was no local board. General ethical approval for the study was obtained from the WHO's Ethics Review Committee. Informed consent was not requested from individual patients (since the data were taken from the medical charts without identifying the women), except in Brazil where an individual consent form was requested from each woman participating in the study.[13,23] The present secondary analysis was approved by the WHO unit responsible for the study database.

Statistical analysis

The prevalence rate of induced labour (as opposed to spontaneous labour) and the total number of deliveries was described according to country and indication as stated in the clinical records. Then the success rates in achieving vaginal delivery were calculated for each country according to the method of labour induction. For this study an operational definition of 'elective induction' was considered when no specific medical indication, either maternal or fetal, was stated in the files. Although maternal request is widely used in the same definition worldwide, it was

considered separately in the WHO data collection form for the Global Survey. To assess the general characteristics of the women and their pregnancies as predictors of labour induction, the data from women in whom labour was induced was compared to that from women who spontaneously went into labour. Crude and adjusted OR and their respective 95% confidence intervals (95% CI) were estimated using simple and multiple logistic regression models.

To assess maternal and perinatal outcomes and complications associated with induced labour, crude and adjusted risk ratios and their 95% CIs were estimated using the Cox regression model adjusted for all predictors except body mass index (BMI, because of the large number of cases in which BMI data were missing). The database has no information regarding the use of electronic fetal monitoring or oxytocin infusion pumps as tools to improve the safety of labour induction. All the procedures used in the statistical analysis were performed using the SAS software program, version 9.1.3 (SAS Institute Inc., Cary, NC, USA).

Results

The number of participating institutions per country ranged from six in Paraguay to 21 in Mexico. The number of deliveries per country ranged from approximately 3500 in Paraguay to 21 000 in Mexico. The majority of the healthcare institutions were in urban areas. Twelve hospitals were private, 86 were public and 22 were social security hospitals. Data for the principal primary variables were missing in <1% of cases.

A total of 11 077/97 095 women (11.4%) underwent induction of labour and 14 525/97 095 (14.9%) elective caesarean section. The public hospitals were responsible for 74.2% of inductions and the social security hospitals for 20.9%, while only 4.9% of inductions occurred in private hospitals. The induction rate in the three types of hospitals was similar at 13.2%, 14.5% and 12.1% respectively. Table 1 shows the prevalence of induced labour per country, ranging from 5.1% in Peru to 20.1% in Cuba. Brazil and Mexico, the countries that contributed the greatest number of cases, had similarly intermediate induced labour rates of around 12%. Premature rupture of membranes was the single most frequent medical indication in all countries. Elective induction, defined as when there was no medical indication stated for the procedure, was the most frequent indication, representing almost 29% of all cases of induced labour when all the countries were taken together and more than 44% in Mexico, Paraguay and Ecuador.

Table 1. Indication for induction of labour according to some selected Latin American countries

Indication for labour induction	Latin America		Argentina		Brazil		Cuba		Ecuador		Mexico		Nicaragua		Peru		Paraguay	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Fetal Death**	307	2.8	27	3.0	53	2.9	49	1.9	25	2.1	62	2.5	15	1.4	63	7.7	13	5.0
Growth Restriction**	368	3.3	59	6.6	32	1.7	199	7.8	28	2.3	22	0.9	5	0.5	21	2.6	2	0.8
Fetal Distress***	660	6.0	12	1.3	245	13.3	155	6.1	95	7.8	109	4.4	13	1.2	7	0.9	24	9.3
Multiple Pregnancy***	232	2.1	10	1.1	17	0.9	18	0.7	5	0.4	177	7.2	4	0.4	1	0.1	0	0.0
PROM****	2805	25.3	271	30.2	602	32.7	924	36.4	206	17.0	394	16.0	152	14.5	204	25.1	52	20.2
Chorioamnionitis****	108	1.0	14	1.6	15	0.8	41	1.6	3	0.2	16	0.6	4	0.4	13	1.6	2	0.8
Vaginal Bleeding****	146	1.3	1	0.1	37	2.0	7	0.3	7	0.6	72	2.9	1	0.1	5	0.6	16	6.2
Pre eclampsia****	831	7.5	73	8.1	206	11.2	224	8.8	69	5.7	126	5.1	44	4.2	80	9.8	9	3.5
Post term****	978	8.8	95	10.6	151	8.2	438	17.3	48	4.0	140	5.7	34	3.2	66	8.1	6	2.3
Elective Induction****	3200	28.9	216	24.1	533	29.0	226	8.9	662	54.5	1098	44.5	98	9.3	239	29.4	128	49.6
Maternal Request****	119	1.1	7	0.8	7	0.4	7	0.3	11	0.9	72	2.9	3	0.3	0	0.0	12	4.7
Other Pregnancy Complications***	1555	14.0	159	17.7	131	7.1	178	7.0	119	9.8	116	4.7	664	63.2	175	21.5	13	5.0
Other Medical Complications***	428	3.9	32	3.6	112	6.1	132	5.2	38	3.1	64	2.6	21	2.0	27	3.3	2	0.8
Inductions	11 077*	11.4	897	8.3	1840	12.1	2536	20.1	1214	9.8	2467	11.8	1051	18.6	814	5.1	258	7.3
Elective CS	14 525	14.9	2000	18.6	2463	16.2	2175	17.2	1072	8.6	3515	16.8	442	7.8	2127	13.3	731	20.7
Grand Total	97 095*		10 748		15 197		12 642		12 414		20 892		5636		16 041		3525	

Values in parenthesis are expressed in percentage.
*660 cases had more than one indication.
**38 cases missing.
***40 cases missing.
****39 cases missing.

Table 2. Success of induction of labour in achieving vaginal birth according to each method of induction in selected Latin American countries

Method of induction of labour	Total inductions (% having vaginal birth)	Argentina		Brazil		Cuba		Ecuador		Mexico		Nicaragua		Peru		Paraguay	
		Total*	% vag. birth	Total*	% vag. birth	Total	% vag. birth	Total	% vag. birth	Total	% vag. birth	Total	% vag. birth	Total	% vag. birth	Total**	% vag. birth
Oxytocin	7913 (69.9)	436	53.7	1571	72.0	2149	57.7	875	88.0	1539	78.0	874	71.1	340	66.2	129	81.4
Mixed***	1762 (71.0)	312	68.9	176	67.6	92	65.2	227	67.0	742	72.2	49	83.7	46	71.7	118	80.5
Misoprostol	1170 (74.8)	127	60.6	76	63.2	294	74.5	85	78.8	32	84.4	126	84.9	427	76.6	3	100.0
Other prostaglandin	164 (64.6)	11	81.8	11	72.7	0	–	4	75.0	132	62.1	0	–	1	100.0	5	60.0
Artificial ROM	59 (74.6)	6	50.0	6	66.7	1	100.0	22	100.0	19	57.9	2	50.0	0	–	3	66.7
Sweeping Membranes	9 (55.6)	5	60.0	0	–	0	–	1	100.0	3	33.3	0	–	0	–	0	–
Total induced	11 077 (70.5)	897	60.3	1840	71.2	2536	60.0	1214	83.8	2467	75.3	1051	73.3	814	72.0	258	80.6

Values in parenthesis are expressed in percentage.
*Three missing cases.
**Ten missing cases.
***1251 cases correspond to oxytocin plus another method.

Post-term pregnancy (above 42 weeks) was the third overall most frequent indication for labour induction. Cuba and Nicaragua were the countries in which elective induction was least common, accounting for around 9% of cases of induced labour in these countries. Induction because the mother requested the procedure accounted for only 1.1% of all inductions. Nicaragua was the only country where other, unspecified complications of pregnancy constituted the most prevalent indication for labour induction (63.2%).

The rate of successful induction (i.e. resulting in vaginal delivery) was 70%, ranging from 60% in Argentina and Cuba, 70–75% in Brazil, Peru, Nicaragua and Mexico, and reaching slightly more than 80% in Paraguay and Ecuador. Overall, the rate of vaginal delivery was 5% points higher after misoprostol induction than after oxytocin, although this was reversed in Brazil and Ecuador (Table 2). Of the methods used, oxytocin alone was the most common. The use of misoprostol was only higher than that of oxytocin in Peru, where it was responsible for 52% of all inductions. Overall, misoprostol was used in only about 10% of all labour inductions. The use of other prostaglandins alone was very uncommon in these countries, as was the practice of artificial rupture of membranes and membrane sweeping.

Table 3 shows the maternal characteristics associated with labour induction. Overall, the rate of induced labour was 20–40% lower for women who were under 20 years of age, those with no partner, women who had more than three previous deliveries, those whose previous pregnancy had resulted in caesarean section, and women who had attended a greater number of prenatal visits. On the other hand, the induction rate was higher in women of 35 years of age or over, those having their first child, women with premature rupture of membranes, hypertension during pregnancy, chronic hypertension, pre-eclampsia, diabetes, severe anaemia, vaginal bleeding, other pathological conditions, gestational age >42 weeks, nonpelvic presentation, those suspected of having fetal growth restriction, and in those giving birth in a social security hospital. This increased risk ranged from around 20% higher when the hospital was a social security hospital (OR 1.21; 99% CI 1.13–1.30) to around four times higher in those with a case of gestational age of >42 weeks (OR 3.85; 99% CI 2.39–6.22).

With respect to the maternal complications associated with induced labour, Table 4 shows an association, even following adjustment for predictive variables, between induced labour and the postpartum use of uterotonic drugs, the occurrence of perineal laceration, puerperal hysterectomy, admission to an intensive care unit, duration of hospitalisation >7 days, and the need to use analgesic/anaesthetic procedures. There were 92 hysterectomies

Table 3. Crude and adjusted estimates of women's characteristics associated with labour induction in some selected Latin American countries

Characteristics	Induced		Spontaneous		OR (95%CI)	OR_{adj} (95% CI)*
	n	(%)	*n*	(%)		
Age (years)						
10–19	1980	17.88	14 250	19.94	0.88 (0.83–0.92)	0.82 (0.77–0.87)
20–34	7991	72.18	50 443	70.58	1.00	1.00
≥35	1100	9.94	6777	9.48	1.02 (0.96–1.10)	1.26 (1.14–1.38)
Missing	6		23			
Marital status						
With partner	8914	19.37	55 333	22.28	1.00	1.00
Without partner	2141	80.63	15 863	77.72	0.84 (0.80–0.88)	0.83 (0.78–0.88)
Missing	22		297			
Years of schooling						
<7	2622	25.24	18 649	27.28	0.74 (0.68–0.79)	1.00 (0.93–1.09)
7–12	6463	62.21	42 888	62.74	0.79 (0.74–0.84)	0.94 (0.87–1.00)
>12	1304	12.55	6826	9.98	1.00	1.00
Missing	688		3130			
Parity						
Primipara	5409	48.87	29 789	41.72	1.31 (1.25–1.36)	1.24 (1.17–1.30)
2–3 deliveries	4475	40.44	32 190	45.09	1.00	1.00
>3 deliveries	1183	10.69	9415	13.19	0.90 (0.84–0.97)	0.84 (0.78–0.90)
Missing	10		99			
Caesarean in the last pregnancy						
Yes	620	5.61	6718	9.46	0.57 (0.52–0.62)	0.60 (0.54–0.65)
No	10 422	94.39	64 318	90.54	1.00	1.00
Missing	35		457			
Rupture of membranes						
No	8398	76.06	64 181	90.26	1.00	1.00
Yes	2643	23.94	6923	9.74	2.92 (2.77–3.07)	2.82 (2.67–2.98)
Missing	36		389			
Hypertension during pregnancy						
No	10 130	91.75	68 510	96.38	1.00	1.00
Yes	911	8.25	2574	3.62	2.39 (2.21–2.59)	2.11 (1.94–2.30)
Missing	36		409			
Chronic hypertension						
No	10 651	96.48	70 437	99.09	1.00	1.00
Yes	389	3.52	647	0.91	3.98 (3.50–4.52)	3.52 (3.06–4.04)
Missing	37		409			
Pre-eclampsia						
No	10 391	94.12	69 088	97.19	1.00	1.00
Yes	649	5.88	1994	2.81	2.16 (1.98–2.37)	1.85 (1.67–2.04)
Missing	37		411			
Cardiac/renal disease						
No	10 985	99.50	70 805	99.61	1.00	1.00
Yes	55	0.50	276	0.39	1.28 (0.96–1.72)	0.91 (0.65–1.27)
Missing	37		412			
Respiratory disease						
No	10 946	99.15	70 700	99.46	1.00	1.00
Yes	94	0.85	381	0.54	1.59 (1.27–2.00)	1.13 (0.88–1.44)
Missing	37		412			
Low fundal height						
No	10 706	97.06	70 426	99.21	1.00	1.00
Yes	324	2.94	559	0.79	3.81 (3.32–4.38)	3.55 (3.06–4.13)
Missing	47		508			

Table 3. (*Continued*)

Characteristics	Induced		Spontaneous		OR (95%CI)	OR_{adj} (95% CI)*
	n	(%)	*n*	(%)		
Diabetes						
No	10 887	98.61	70 775	99.57	1.00	1.00
Yes	153	1.39	307	0.43	3.24 (2.67–3.94)	2.70 (2.18–3.34)
Missing	37		411			
Severe anaemia						
No	10 891	98.66	70 781	99.58	1.00	1.00
Yes	148	1.34	297	0.42	3.24 (2.66–3.95)	2.62 (2.11–3.25)
Missing	38		415			
Vaginal bleeding						
No	10 736	97.31	69 818	98.26	1.00	1.00
Yes	297	2.69	1236	1.74	1.56 (1.37–1.78)	1.32 (1.15–1.51)
Missing	44		439			
Other conditions						
No	9839	89.14	64 556	90.82	1.00	1.00
Yes	1199	10.86	6525	9.18	1.21 (1.13–1.29)	1.16 (1.08–1.24)
Missing	39		412			
Number of prenatal visits						
0–3	1493	13.91	12 974	18.84	1.00	1.00
>3	9241	86.09	55 879	81.16	1.44 (1.36–1.52)	0.80 (0.75–0.85)
Missing	343		2640			
Type of healthcare facility						
Public	8217	74.18	53 956	75.47	1.00	1.00
Social security	2320	20.94	13 606	19.03	1.12 (1.07–1.18)	1.20 (1.12–1.38)
Private	540	4.88	3931	5.50	0.90 (0.82–0.99)	1.10 (0.97–1.26)
BMI						
≤30	5062	52.48	33 042	57.36	1.00	Not used**
>30 (obesity)	4583	47.52	24 566	42.64	1.22 (1.17–1.27)	
Missing	1432		13 885			
Gestational age (weeks)						
<37	884	8.02	5215	7.33	1.11 (1.03–1.19)	0.98 (0.90–1.06)
37–42	10 090	91.54	65 814	92.54	1.00	1.00
>42	48	0.44	93	0.13	3.37 (2.37–4.77)	3.82 (2.66–5.51)
Missing	55		371			
Fetal presentation						
Cephalic	10 797	97.76	68 787	96.32	2.07 (1.74–2.46)	2.29 (1.90–2.76)
Breech	141	1.27	1859	2.61	1.00	1.00
Other	107	0.97	767	1.07	1.84 (1.41–2.40)	2.03 (1.53–2.69)
Missing	32		80			

OR, odds ratio; OR_{adj}, adjusted odds ratio.
*Simple and multiple logistic regression model (including all variables except BMI).
**BMI was not used in multiple analyses because of the high frequency of missing data.

performed, 70 in the spontaneous labour group (a rate of around 0.1%) and 22 in the induced labour group (a rate of around 0.2%). The latter occurred in 15 women who received oxytocin, two who received misoprostol and five who had more than one method. In this sample, 17 maternal deaths occurred, five in the induced group (a rate of around 0.05%) and 12 in the spontaneous group (a rate of around 0.02%). The majority of these deaths were associated with hysterectomies, need of postpartum uterotonic, postpartum haemorrhage, blood transfusion and admission to intensive care unit.

Table 5 shows that compared to spontaneous labour, induced labour was a risk factor for 5th minute Apgar score <7, for very low birthweight infants and for admission to a

Table 4. Crude and adjusted risk ratios of maternal outcomes among women who underwent labour induction in some selected Latin American countries

Maternal outcomes	Induced		Spontaneous		RR (95% CI)	RR_{adj} (95% CI)*
	n	(%)	*n*	(%)		
Postpartum haemorrhage requiring blood transfusion						
No	10 878	99.42	69 718	99.63	1.0	1.0
Yes	63	0.58	257	0.37	1.57 (1.09–2.26)	1.32 (0.98–1.77)
Missing	136		1518			
Need for postpartum uterotonic medication						
No	8186	74.03	55 633	78.12	1.0	1.0
Yes	2871	25.97	15 580	21.88	1.19 (1.13–1.24)	1.15 (1.04–1.21)
Missing	20		280			
Blood transfusion						
No	10 878	98.44	70 419	98.89	1.0	1.0
Yes	172	1.56	793	1.11	1.40 (1.13–1.74)	1.15 (0.97–1.37)
Missing	27		281			
Perineal laceration						
No	10 902	98.73	70 796	99.52	1.0	1.0
Yes	140	1.27	345	0.48	2.61 (2.02–3.39)	2.17 (1.75–2.70)
Missing	35		352			
Hysterectomy						
No	11 021	99.80	71 071	99.90	1.0	1.0
Yes	22	0.20	70	0.10	2.02 (1.07–3.82)	2.02 (1.21–3.39)
Missing	34		352			
Admission to intensive care unit						
No	10 924	98.72	70 944	99.33	1.0	1.0
Yes	142	1.28	477	0.67	1.92 (1.50–2.46)	1.36 (1.11–1.66)
Missing	11		72			
Postpartum hospital stay						
<7 days	10 762	97.41	70 244	98.43	1.0	1.0
≥7 days	286	2.59	1123	1.57	1.65 (1.39–1.95)	1.30 (1.13–1.49)
Missing	29		126			
Anaesthesia during labour						
No anaesthesia/Analgesia	7684	69.75	53 669	75.36	1.0	1.0
Epidural	1481	13.45	9931	13.95	1.03 (0.98–1.09)	1.13 (1.06–1.19)
Spinal	337	3.06	1263	1.77	1.83 (1.62–2.06)	1.73 (1.51–1.99)
Parenteral analgesic	1172	10.64	3872	5.44	1.97 (1.85–2.09)	1.87 (1.74–2.01)
Alternative methods	341	3.10	2480	3.48	0.96 (0.86–1.07)	1.19 (1.06–1.35)
Missing	62		278			
Status at discharge						
Alive	11 049	99.81	71 359	99.87	1.0	1.0
Dead	5	0.05	12	0.02	2.69 (0.67–10.73)	2.06 (0.63–6.74)
Referred to higher level	16	0.14	91	0.13	1.14 (0.56–2.30)	0.99 (0.56–1.74)
Missing	7		31			

RR, risk ratio; RR_{adj}, adjusted risk ratio.
*Cox regression model with adjustment for all predictors in Table 3 except BMI.

neonatal intensive care unit, even following adjustment for all predictors. With respect to the time of initiation of breastfeeding, induced labour was associated with a reduced likelihood of initiating breastfeeding in the first 24 hours following delivery and an increased risk of postponing breastfeeding until after the first day.

Discussion

In the 120 large hospitals of Latin America included in this study, the prevalence of induced labour was 11.4%. This is lower than that reported for developed countries, which is around 20%.[1,4–6] This lower prevalence may be because of

Table 5. Crude and adjusted risk ratios of perinatal outcomes among women who underwent labour induction in some selected Latin American countries

Neonatal outcomes	Induced		Spontaneous		RR (95% CI)	RR_{adj} (95% CI)*
	n	(%)	*n*	(%)		
Apgar 5th minute						
<7	481	4.35	1498	2.11	2.07 (1.87–2.29)	2.08 (1.86–2.33)
≥7	10 564	95.65	69 660	97.89	1.0	1.0
Missing	32		335			
Low birthweight (<2500 g)						
<2500 g	967	8.75	5502	7.71	1.14 (1.06–1.21)	1.01 (0.94–1.09)
≥2500 g	10 081	91.25	65 877	92.29	1.0	1.0
Missing	29		114			
Very low birthweight (<1500 g)						
<1500 g	224	2.03	851	1.19	1.70 (1.47–1.97)	1.59 (1.35–1.86)
≥1500 g	10 824	97.97	70 528	98.81	1.0	1.0
Missing	29		114			
Admission to neonatal intensive care unit						
No	9444	88.13	64 577	91.03	1.0	1.0
Yes	1272	11.87	6366	8.97	1.32 (1.25–1.40)	1.26 (1.18–1.35)
Missing	361		550			
Early neonatal death						
Alive	10 674	99.39	70 563	99.47	1.0	1.0
Early neonatal mortality	65	0.61	373	0.53	1.15 (0.89–1.50)	1.33 (0.99–1.77)
Missing	338		557			
Breastfeeding started						
Within first hour	5974	55.78	34 123	48.35	1.0	1.0
Between 1 and 24 h after birth	3669	34.25	31 583	44.75	0.79 (0.77–0.81)	0.82 (0.77–0.85)
After the first day	762	7.11	3222	4.57	1.31 (1.22–1.41)	1.31 (1.21–1.43)
Not before the 7th day	306	2.86	1644	2.33	1.06 (0.94–1.19)	1.18 (1.04–1.35)
Missing	366		921			

RR, risk ratio; RR_{adj}, adjusted risk ratio.
*Cox regression model with adjustment for all predictors in Table 3 except BMI.

the very low threshold for caesarean delivery in Latin America. This results in a very high rate of elective caesarean sections at 33% of all deliveries of which 49% are elective.[8] This compares to much lower rates elsewhere in the world. Finland, for example, has a rate of only 7.1%.[25]

In the present study, the commonest medical indication for labour induction in all the countries studied was premature rupture of membranes. This contrasts with studies carried out in the United States in which pre-eclampsia and postdates pregnancies were the most common indications followed by premature rupture of membranes in third place.[6] Yawn *et al.*[26] also reported a significant reduction in the prevalence of induction because of premature rupture of membranes between 1980 and 1995. However, in France, the most common indication was post-dates pregnancy followed by ruptured membranes.[5] In this study, pre-eclampsia was only the fifth most frequent indication for induction in Latin America. On the other hand, the proportion of inductions classified as elective were fairly high, around 30% overall and over 44% in Ecuador, Mexico and Paraguay. We were not able to find a simple possible explanation for these high proportions of labour induction in these three countries. This proportion of elective inductions is much higher than the range of 6–24.8% reported by various authors.[3,5,6,26] It is probable, however, that this high proportion of elective inductions is over-estimated and may also include other medical indications for induction that, since they permitted the induction to be scheduled, may have been misclassified as elective. Around 6% of patients had more than one indication for labour induction, a similar proportion to that reported by Yawn *et al.*[26]

The predominance of the use of oxytocin as the preferred method of induction in Latin America is in agreement with other studies that have reported its use in 85–100% of inductions, mainly in cases in which the cervix

was favourable to induction.[5,27–29] The decision whether to induce with oxytocin or misoprostol was probably not dependent on the favourability of the woman's cervix, but more on their availability and culture within the unit. We did not have the data, however, to demonstrate this. In Brazil, one of the few countries in which misoprostol is available at a dose of 25 μg specifically for cervical ripening and labour induction,[30] its use alone in this study was reported in only 4.1% of cases. Nevertheless, misoprostol was used in around 10% of cases of induced labour, either alone or with other agents.

The success rate for vaginal delivery was 70% and this rate varied little in accordance with the country or the method used. Although high, this rate is still lower than the 83% reported for other regions.[5,28] However, it is known that labour induction when the cervix is unfavourable reduces the success rate of induction.[28] Nonetheless, data on the status of the cervix and whether a ripening agent was required prior to induction was not collected in this study at all, making it impossible to draw any conclusions. The number of women who used more than one method of induction, around 16%, is small considering that the use of oxytocin is very common in the induction process[31,32] and that the presence of a favourable cervix is not common with medical or elective induction. Artificial rupture of membranes and membrane sweeping were rarely reported. It may be, however, that they were not always reported by the clinicians.

Nulliparity and age over 35 years were risk factors for labour induction. This is in agreement with other studies,[15–17] although the study by MacDorman *et al.*[33] which analysed 10 years of induction in the United States found no effect of age on the prevalence of induction. In this study, having a previous caesarean section significantly reduced the likelihood of labour induction as expected, probably due to concerns by practitioners about reported increases in uterine rupture rates. Although misoprostol is formally contraindicated with a previous caesarean section, some studies have shown good results,[34] while others report an increased risk of uterine rupture and adverse neonatal results.[35,36] In fact, systematic reviews on the subject conclude that there is insufficient data to define the optimal route of delivery, either elective caesarean section or trial of labour, or whether induction is a safe procedure, and that any decision should be taken with the utmost care.[37,38] In our survey, misoprostol for woman with uterine scars was only used in a few University hospitals. In general, the other risk factors for induced labour reflect the indications for labour induction. In this analysis, we did not compare the maternal and perinatal outcomes from labour induction with those from elective caesarean sections as originally planned because there were not enough caesarean cases for a meaningful analysis.

The results of the present study show that labour induction is associated with higher rates of some maternal complications, including the need for uterotonic drugs in the postpartum, perineal laceration, hysterectomy, admission to an intensive care unit, longer hospital stay and greater need for analgesic/anaesthetic procedures when compared to women with a spontaneous onset of labour. This has also been found in several other studies.[3,17,39] These data, originating from such a large and extensive sample population, merit careful reflection with respect to the recommendation of the inclusion of induced labour as a routine practice for these indications, and an evaluation of the services for the management of possible complications. These risks remained even after adjustment for a number of factors associated with the underlying conditions that resulted in the need for labour induction. Nevertheless, the underlying condition may have contributed to the poor outcomes from labour induction. However, it may also have occurred as a result of the induction process itself. This database did not have any information on the use of electronic fetal heart rate monitoring or on the use of oxytocin infusion pumps, but it is generally believed that these increase the safety of labour induction. With many health facilities in the study not having these monitoring systems available, the rate of fetal adverse outcomes could have been increased by unintentional uterine hyperstimulation and unrecognised fetal hypoxia. The perinatal outcomes could possibly be improved if they were available for all women to whom labour induction was indicated.

In this study, induction was associated with lower 5th minute Apgar scores even following adjustment for confounding factors. This is in contrast to studies conducted in settings with infusion and fetal heart rate monitors where there was no difference in Apgar scores between cases of medically indicated or elective induced labour and spontaneous labour.[16,17,26] The same could be said with respect to the higher risk (even after adjustment) of very low birthweight infants and admission to neonatal intensive care units. Although this would be influenced by variations in the standard of care, the high numbers studied in this survey suggest possible adverse neonatal outcomes associated with the induction of labour.

Conclusion

Labour induction is a relatively underused obstetrical procedure in Latin America when compared to developed countries. The success rate for vaginal delivery is high, with no significant difference between the countries evaluated or between the different methods used. In Latin America where caesarean section rates are very high, the message that labour induction is an effective procedure that could be used instead of caesarean section is important. In this

study, however, induced labour was associated with an increased maternal and perinatal risk, for which reason caution is recommended in the use of this procedure. The indication for induction and the resources available at the institution for the care of the woman and her newborn infant are factors that must be taken into consideration when indicating induced labour.

Disclosure of interests
There are no conflicts of interests

Contribution to authorship
JGC had the original idea for this secondary analysis. GVG, JGC and JPS designed the plan of analysis which was performed by SSM. AMG, AF, JGC, JPS, MAP, RPJ and GC saw the first output analysis and gave important suggestions on how to proceed. GVG and JGC wrote the first version of the manuscript. All of them have discussed, suggested and contributed to the final version whose content they agree with.

Details of ethics approval
The original study was ethically approved by WHO and by all participating countries. The current analysis got the approval of the WHO unit responsible for the database.

Funding
The original study was funded by the WHO and USAID. The current analysis was sponsored by the University of Campinas, Brazil.

Acknowledgements
We thank all those people who got involved with the planning, implementation, data collection, analysis and reporting of the 2005 WHO Global Survey on Maternal and Perinatal Health. ■

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