Factors associated with preterm births in Southeast Brazil: a comparison of two birth cohorts born 15 years apart

Heloisa Bettiol,[a] Roberto J. Rona,[b] Susan Chinn,[b] Marcelo Goldani[a] and Marco A. Barbieri[a]

[a]*Department of Paediatrics, Faculty of Medicine of Ribeirão Preto, University of São Paulo, Brazil, and* [b]*Department of Public Health Sciences, Guy's, King's and St Thomas' Hospitals' Medical and Dental Schools, London, UK*

Correspondence:
Professor Roberto J. Rona, Department of Public Health Sciences, 5th Floor, Capital House, 42 Weston St, London SE1 3QD.
E-mail: r.rona@umds.ac.uk

Summary

An increase in preterm deliveries in Ribeirão Preto stimulated an analysis of possible explanatory factors. Two cohorts of singleton livebirths were studied, the first based on 6746 births in 1978–9 and the second based on 2846 births in 1994. A logistic regression was carried out to assess the association of preterm birth with several socio-demographic, behavioural and clinical variables, including year of survey. Delivery in private settings compared with a public setting, maternal age of $\leqslant 17$ compared with any other age group, and mothers who had had previous abortions and previous stillbirths were associated with greater rates of preterm birth. Although there was an increase in preterm birth rates regardless of mode of delivery, the increase was greater in the caesarean section group than in the vaginal delivery group. Over the study period, deliveries in private hospitals and caesarean section operations increased markedly (from 4% to 36% and from 30% to 51% respectively). Caesarean section may be the main contributor to the increase of preterm birth rate in this study. It is essential to ensure that health-care staff, especially those in private facilities, are properly educated and audited.

Introduction

Preterm birth, defined as delivery at less than 37 weeks of gestation, is one of the most important contributing factors to infant morbidity and mortality.[1–5] The trend over time of preterm birth rate varies according to population. There are reports showing an increase or lack of change in the preterm birth rate,[1,6,7] whereas others have shown a decrease over time.[8,9]

Information on the preterm birth rate from countries in economic transition is still limited.[4,10] Large studies on this subject are scarce in these countries because it is difficult to obtain complete and accurate information on length of gestation.[11] In Brazil, the preterm low-birthweight rate was reported to be 5% in the 1980s,[12] and another study showed an increase in the preterm birth rate from 5.6% to 7.5% between 1982 and 1993.[13] Preterm birth was associated with mortality in the first year of life in 31.4% of the cases reported in a study in 1987, whereas the rate was only 2.9% among the survivors.[2]

In Ribeirão Preto, a city in Southeast Brazil, an increase from 7.2% to 10.6% in low-birthweight rate over a 15-year interval was shown, despite improvements in social, educational and economic indicators and a decline in infant mortality rate.[14] In the same period, the preterm birth rate rose from 7.6% to 13.6%. The aim of this study was to identify factors associated with preterm deliveries and ascertain whether these factors could explain the increasing preterm birth rate. For this purpose, the total childbearing population of Ribeirão Preto was studied using information from two surveys, the first in 1978–9 and the second in 1994.

Materials and methods

Ribeirão Preto is a regional and university centre in the northeast region of São Paulo State, Southeast Brazil. The city has one of the highest per capita incomes in Brazil, US$5800 per year in 1991, and the main economic activities are sugar cane cultivation,

commerce, finance and services. Its population increased from 318 496 inhabitants in 1978–9 to 461 427 in 1994.[15]

Hospital deliveries have accounted for at least 98% of all births since 1978.[16] All maternity hospitals in the city participated in the surveys, eight in 1978–9 and 10 in 1994 and, for the purpose of this analysis, the methodology was the same in both surveys.[16,17] Consent and ethical approval for the study was obtained from clinical directors and the ethical committees from all hospitals. All singleton live births of resident families were included in the analysis. In the first survey, data were collected from 6746 deliveries from June 1978 to May 1979. In the second, as there was no seasonal variation in birthweight or preterm birth rates in 1978–9,[16] 2846 births were studied from May to August 1994. While in hospital, the mothers were asked to answer a questionnaire on socio-demographic information and questions related to the current and to previous pregnancies. Birthweight was ascertained by trained personnel supervised by the research team. Less than 1% of mothers in either survey refused to be interviewed, but 2.5% of the mothers in the first survey and 3.2% in the second survey were discharged from the hospital before being interviewed. Minimal data were available for these groups from medical records. Thus, all births were included, although data were missing for some of the mothers because the replies to some questions were not found in the medical notes. The length of gestation was measured according to the first day of the last menstrual period. The delivery was defined as preterm if it took place before the completion of 37 weeks of gestation.

The following independent variables were used in this analysis: newborn gender (male, female, not known), maternal schooling in years ($<$ 4, 4, 5–8, 9–11, $\geqslant$ 12, not known), maternal smoking during pregnancy (number of cigarettes per day; 0, 1–5, 6–10, $\geqslant$ 11, not known), maternal work (housewife, outside the home, not known), maternal marital status (non-cohabiting, cohabiting, married, not known), maternal age ($\leqslant$ 17, 18 or 19, 20–24, 25–29, 30–34, $\geqslant$ 35, not known), parity, including the current pregnancy (1, 2, 3, $\geqslant$ 4, not known), previous abortion (no, yes, not known), previous stillbirth (no, yes, not known), number of live births (1, 2, 3, $\geqslant$ 4, not known), mode of insurance (state, private, not known), type of hospital (hospitals covering predominantly publicly insured patients, hospitals covering predominantly privately insured patients, not known), number of antenatal visits (0, 1–3, 4–6, $\geqslant$ 7, not known), type of delivery (vaginal, caesarean section, not known), family income in multiples of the Brazilian official definition of a minimum wage ($<$3, $\geqslant$ 3, not known) and occupation group. The last was considered to be a marker of socio-economic status and was divided into three categories: group 1 included non-manual workers, group 2 included skilled and semiskilled manual workers, and group 3 included the unskilled or unemployed.[18] Paternal occupation was used for the coding of the occupational group in most cases. If unavailable, especially for non-cohabiting and married women, maternal occupation was used instead.

A logistic regression model was fitted to assess the factors associated with preterm birth for the two cohorts together. The year of survey, 1978–9 or 1994, was added as an independent variable. The model was used to identify factors related to the trends in preterm birth rates over time, to account for confounding and to assess the interactions of year of survey and other independent variables on preterm births. The independent variables were those mentioned above. Birthweight was not included in the model because it is highly associated with preterm birth. However, we examined birthweight according to duration of gestation and eliminated from the analysis 38 newborn babies in which the birthweight was above the 99th percentile for length of gestation.[19] The analysis used backward elimination and the final model included only the variables associated with the dependent variable at 0.10 significance level. Further analysis was carried out, stratifying by type of delivery, caesarean section or vaginal, to understand fully the effect of year of survey on preterm rates.

Because women who deliver prematurely would have less opportunity for prenatal visits, the association between number of prenatal visits regardless of the length of gestation and preterm births can be misleading.[20] We performed a further logistic regression analysis including a measurement of prenatal care utilisation, the Adequacy of Prenatal Care Utilisation Index (APNCU),[21] as an independent variable. The analysis was performed only for the 1994 cohort, which contained information on the components of the index: week of gestation at the first prenatal visit and adequacy of frequency of visits once prenatal care began. This information was not available for the 1978–9 cohort.

Results

Information on gestational age was available for 75.4% of the mothers in the first survey and for 81.7% in the second. Preterm birth rate increased from 7.6% in 1978–9 to 13.6% in 1994 ($P < 0.001$). The rise was higher for duration of pregnancy between 32 and 36 weeks (Table 1). We investigated whether newborns with no information on gestational age were different in 1978–9 and 1994. Mean birthweight of children in the not-known and the full-term categories was 0.1 kg less in 1994 than in 1978–9 (Table 2).

Table 3 shows the variables associated with preterm births in the logistic regression analysis including both cohorts. Preterm birth rate was associated with social class ($P = 0.006$), increasing among mothers who did not disclose information on occupation and also slightly so in the skilled/semiskilled group. Mothers aged $\leqslant 17$ years ($P < 0.001$), those having a previous abortion ($P < 0.001$), those who had a previous stillbirth ($P = 0.031$) and those who delivered in private hospitals ($P = 0.045$) were more likely to have a preterm delivery. For completeness, we included number of prenatal visits unadjusted for gestation in the analysis ($P < 0.001$). The associations described above did not change after eliminating number of prenatal visits from the model.

The interaction between type of delivery and year of survey on preterm birth rate was significant ($P = 0.021$). In the first analysis (not shown), the interaction of maternal smoking and year of survey was also significantly associated with preterm delivery ($P < 0.001$). However, the significant interaction was due to the high percentage of preterm births in the unknown category. Once the not-known category was eliminated from the analysis, the interaction was no longer significant and smoking was not associated with preterm rates.

The significant interaction between type of delivery and year of survey on preterm rates made the interpretation of the effect of year of survey on preterm rates difficult. Thus, further analyses were carried out, stratifying by type of delivery. Tables 4 and 5 show the variables associated with preterm delivery in the vaginal delivery group and those delivered by caesarean section respectively. Year of survey was highly significantly associated with preterm delivery in the adjusted and unadjusted model in both types of delivery ($P < 0.001$). However, the odds ratios of preterm rates in the second survey compared with the first survey was higher in the caesarean section group than in the vaginal delivery group. In the vaginal delivery group, the same variables were significantly associated with preterm rates as in the total group, except that the stillbirth variable was no longer associated with preterm rates. In the caesarean section group, social class and type of hospital were not significantly associated with the outcome variable ($P > 0.1$). The unadjusted associations (only adjusted for year of survey) were similar to the adjusted odds ratios with the exception of type of hospital, which was not significantly associated with preterm rates in the unadjusted analysis in the vaginal delivery group.

The APNCU index was highly associated with preterm birth rates in the 1994 survey after adjustment for all significant independent variables in the analysis ($P < 0.001$). Mothers who received intensive care during pregnancy were more likely to give birth to a preterm child (Table 6).

A comparison was made between the two surveys, 1978–9 and 1994, for variables significantly associated with preterm births. Caesarean sections, deliveries in

Table 1. Distribution of length of gestation (in completed number of weeks) in singleton livebirths in Ribeirão Preto, 1978–9 and 1994

Length of gestation (weeks)	1978–9		1994	
	n	%	*n*	%
$\leqslant 30$	44	0.9	24	1.0
31	9	0.2	8	0.3
32	22	0.4	23	1.0
33	23	0.4	25	1.1
34	66	1.3	55	2.4
35	75	1.5	65	2.8
36	145	2.9	116	5.0
< 37 (total)	384	7.6	316	13.6
37–42	4575	90.0	1958	84.2
43–44	126	2.4	51	2.2
Total	5085	100	2325	100

Table 2. Birthweight distribution (g) by gestational age and year of survey

Gestational age	1978–9		1994	
	n	Mean (SD)	*n*	Mean (SD)
< 37 weeks	380	2574 (713)	314	2558 (694)
$\geqslant$ 37 weeks	4685	3311 (473)	2007	3212 (453)
Not known	1649	3175 (568)	518	3064 (610)
Total	6714	3236 (540)	2839	3113 (554)

Table 3. Variables associated with preterm births in singleton livebirths in Ribeirão Preto[a]

Variable	Total	*n*	%	OR [95% CI]	*P*
Occupation					0.006
Non-manual workers	1457	101	6.9	1.00 Reference	
Skilled/semiskilled workers	4352	425	9.8	1.31 [1.03,1.68]	
Unskilled workers/unemployed	1357	135	10.0	1.12 [0.82,1.51]	
Not known	244	39	16.0	1.62 [0.97,2.71]	
Number of prenatal visits					< 0.001
0	313	60	19.2	1.00 Reference	
1–3	728	118	16.2	0.86 [0.60,1.24]	
4–6	2193	212	9.7	0.49 [0.35,0.69]	
⩾ 7	3567	268	7.5	0.27 [0.19,0.39]	
Not known	609	42	6.9	0.25 [0.15,0.41]	
Maternal age (years)					< 0.001
⩽ 17	384	75	19.5	1.00 Reference	
18 and 19	670	65	9.7	0.51 [0.35,0.74]	
20–24	2357	203	8.6	0.49 [0.36,0.67]	
25–29	2160	175	8.1	0.46 [0.33,0.63]	
30–34	1209	106	8.8	0.47 [0.33,0.67]	
⩾ 35	624	75	12.0	0.61 [0.42,0.89]	
Not known	6	1	16.7	–	
Type of hospital					0.045
Public	6290	570	9.1	1.00 Reference	
Private	1120	130	11.6	1.35 [1.02,1.77]	
Previous abortion(s)					0.001
No	6045	537	8.9	1.00 Reference	
Yes	1347	160	11.9	1.41 [1.15,1.73]	
Not known	18	3	16.6	–	
Previous stillbirth(s)					0.017
No	7211	667	9.2	1.00 Reference	
Yes	183	30	16.4	1.88 [1.23,2.88]	
Not known	16	3	18.8	–	

[a]A significant interaction of year of survey and type of delivery on preterm birth has not been included.

private hospitals, mothers with ⩾ 7 antenatal visits and, to a lesser extent, young teenage mothers increased over the study period (Table 7). The percentage of head of households involved in more qualified occupations increased, whereas those working in manual jobs or unemployed decreased. There was little variation in the percentages of previous abortions or previous stillbirths.

Discussion

The main reason for the current analysis was the unprecedented increase in the preterm birth rate over a 15-year period. The increase in the preterm rates over time was not explained by the independent variables in the analysis; if anything, the odds ratios according to year of survey increased after adjustment in the analyses stratified by type of delivery. However, although the preterm birth rate increased in both groups, the increase was steeper in the caesarean group than in the vaginal delivery group. Preterm births were more prevalent in private than in public hospitals by approximately 30%, and accounted for 36% of the deliveries in 1994 but only 4% in 1978–9. An increase from 5% to 7.4% of teenage mothers between the two surveys may have also contributed slightly to the increase.

The methodology used to ascertain cases in the two surveys was the same. All singleton livebirths were included in the study and duration of gestation was based on the commencement of the last menstrual period in both surveys. Ultrasound technology was not used in the 1970s. Thus, in spite of the fact that the same methodology was used to assess gestational age in both surveys, ultrasound was available in clinical practice in 1994 to ascertain gestational age and it is possible that, inadvertently, this information was used by interviewers on some occasions. It has been shown

Table 4. Variables associated with preterm births in the vaginal delivery group unadjusted model (adjusted only for year of survey) and adjusted for all remaining variables in the final model

Variable	Total	*n*	%	Unadjusted OR [95% CI]	*P*	Adjusted OR [95% CI]	*P*
Occupation					< 0.001		0.008
Non-manual workers	675	46	6.8	1.00 Reference		1.00 Reference	
Skilled/semiskilled workers	2713	267	9.8	1.49 [1.08,2.07]		1.28 [0.91,1.80]	
Unskilled workers/unemployed	976	103	10.6	1.61 [1.12,2.32]		1.15 [0.78,1.70]	
Not known	166	32	19.3	3.27 [2.00,5.32]		2.37 [1.40,4.00]	
Number of prenatal visits					< 0.001		< 0.001
0	258	54	20.9	1.00 Reference		1.00 Reference	
1–3	594	92	15.5	0.69 [0.48,1.03]		0.70 [0.48,1.03]	
4–6	1523	149	9.8	0.41 [0.29,0.58]		0.42 [0.29,0.60]	
7 and over	1798	129	7.2	0.29 [0.21,0.41]		0.25 [0.17,0.37]	
Not known	357	24	6.7	0.27 [0.16,0.45]		0.25 [0.15,0.42]	
Previous abortion(s)					0.086		0.031
No	3733	353	9.5	1.00 Reference		1.00 Reference	
Yes	786	93	11.8	1.28 [1.00,1.64]		1.42 [1.09,1.84]	
Not known	11	2	18.2	2.12 [0.46,9.89]		1.38 [0.27,7.05]	
Maternal age (years)					< 0.001		< 0.001
⩽ 17	286	61	21.3	1.00 Reference		1.00 Reference	
18 and 19	475	49	10.3	0.42 [0.28,0.64]		0.45 [0.29,0.68]	
20–24	1568	142	9.1	0.37 [0.26,0.51]		0.43 [0.30,0.61]	
25–29	1280	105	8.2	0.33 [0.23,0.47]		0.39 [0.27,0.56]	
30–34	618	63	10.2	0.42 [0.29,0.62]		0.46 [0.31,0.69]	
35 and over	301	28	9.3	0.38 [0.23,0.61]		0.35 [0.21,0.59]	
Not known	2	0	0.0	–			
Type of hospital					0.150		0.025
Public	4247	413	9.7	1.00 Reference		1.00 Reference	
Private	283	35	12.4	1.31 [0.91,1.89]		1.60 [1.06,2.42]	
Year of survey					< 0.001		< 0.001
1978–9	3447	297	8.6	1.00 Reference		1.00 Reference	
1994	1083	151	13.9	1.72 [1.39,2.12]		1.93 [1.53,2.42]	

that preterm rates are higher when the assessments are based on ultrasound rather than on date of last menstrual period and that, in part, the positive trend in preterm rates in some countries may be related to changes in the technology used in assessment.[22] However, in this study, the level of contamination owing to new technology, if at all present, must have been small compared with the very large increase in preterm births.

We examined the period of time covered by each survey, changes in stillbirth rates and changes in completeness of information on gestational age as possible sources of bias. As seasonality was not found to be relevant in preterm births rates, maternal age, social class or birthweight distributions in the 1978–9 cohort,[16] nor in the preterm births and birthweight distributions in the hospital data bases in 1993, we believe that the 1994 sample based on a 4-month survey was representative of the births in that year.

We calculated the effect of the reduction in stillbirth rates, from 16.4/1000 births in 1978–9 to 9.4/1000 in 1994.[23] If all the additional surviving cases in 1994 were preterm deliveries, the effect was an extra 16 preterm deliveries, so that if the 1978–9 stillbirth rate had applied the preterm rate in 1994 would have been 12.9% rather than 13.6%.

The unknown information on gestational age decreased by 6.3%, from 24.6% in 1978–9 to 18.3% in 1994. Unknown gestational age is common among women at high risk of preterm delivery.[9] If an extra 6.3% in the unknown group had given information on length of gestation in 1978, we could have expected in that group a risk of preterm delivery of approximately 20%, instead of 7.6% in the total group. We calculated that this increase in information would have changed the preterm rate from 7.6% to 7.9% in 1978–9. The fact that the mean birthweight in the group of not-known length of gestation was 0.1 kg lighter in 1994 than in

Table 5. Variables associated with preterm births in the caesarean section group unadjusted model (adjusted only for year of survey) and adjusted for all remaining variables in the final model

Variable	Total	*n*	%	Unadjusted OR [95% CI]	*P*	Adjusted OR [95% CI]	*P*
Number of prenatal visits					< 0.001		< 0.001
0	55	6	10.9	1.00 Reference		1.00 Reference	
1–3	134	26	19.4	1.97 [0.76,5.08]		2.16 [0.81,5.76]	
4–6	670	63	9.4	0.85 [0.35,2.06]		0.85 [0.34,2.11]	
⩾ 7	1768	139	7.9	0.70 [0.29,1.66]		0.43 [0.17,1.31]	
Not known	252	18	7.1	0.63 [0.24,1.66]		0.48 [0.17,1.30]	
Maternal age (years)					0.002		0.045
⩽ 17	98	14	14.3	1.00 Reference		1.00 Reference	
18 and 19	195	16	8.2	0.54 [0.25,1.15]		0.56 [0.26,1.22]	
20–24	789	61	7.8	0.50 [0.27,0.94]		0.63 [0.33,1.20]	
25–29	879	70	8.0	0.52 [0.28,0.96]		0.64 [0.34,1.22]	
30–34	591	43	7.3	0.47 [0.25,0.88]		0.52 [0.27,1.02]	
⩾ 35	323	47	14.6	1.02 [0.54,1.94]		1.05 [0.53,2.05]	
Not known	4	1	25.0	2.00 [0.19,20.61]		1.84 [0.18,19.37]	
Previous abortion(s)					0.011		0.000
No	2311	184	8.0	1.00 Reference		1.00 Reference	
Yes	561	67	11.9	1.57 [1.17,2.11]		1.66 [1.21,2.27]	
Not known	7	1	14.3	1.93 [0.23,16.09]		–	
Previous stillbirth(s)					0.009		0.006
No	2790	236	8.5	1.00 Reference		1.00 Reference	
Yes	81	15	18.5	2.46 [1.38,4.38]		2.37 [1.29,4.36]	
Not known	8	1	12.5	1.55 [0.19,12.6]		–	
Survey					< 0.001		< 0.001
1978–9	1637	87	5.3	1.00 Reference		1.00 Reference	
1994	1242	165	13.3	2.73 [2.10,3.58]		3.87 [2.85,5.25]	

1978, equivalent to the decrease in the full-term group, gives an indication that the not-known group did not include a disproportionate number of preterm births in 1994 compared with 1978–9.

The caesarean section rate increased from 30.3% in 1978–9 to 50.8% in 1994, and the increase in preterm deliveries was greater in the caesarean section group than in the vaginal delivery group. Thus, it is possible that an increase in the rate of caesarean section was in part responsible for the increase in the preterm birth rates. Janowitz and colleagues[24] demonstrated that a private facility for birth deliveries was the major factor contributing to a high caesarean rate in Brazil. It is, therefore, interesting that over the 15-year period covered by our study there was a major expansion of private facilities in Ribeirão Preto. Patient request, cephalopelvic disproportion, fetal distress and a previous caesarean section were the major indications for caesarean section in Brazil.[25] The widespread use of technology in the evaluation of fetal well-being, which has been claimed to be responsible for the increasing rates of caesarean section in the USA,[26] had no impact on the indication for caesarean section in Brazil.[25]

Young maternal age may have an effect on preterm births *per se* or through the socio-economic circumstances associated with teenage childbearing.[27,28] We

Table 6. Association of adequacy of prenatal care utilisation with preterm birth (1994 cohort) after controlling for all independent variables using logistic regression

Adequacy of prenatal care utilisation	Total	*n*[a]	%	OR [95%CI]	*P*
Intensive	393	135	34.4	1.00 Reference	< 0.001
Adequate	755	61	8.1	0.17 [0.12, 0.24]	
Intermediate	769	79	10.3	0.18 [0.13, 0.25]	
Inadequate	408	41	10.1	0.16 [0.10, 0.23]	

[a]Number of preterm births; 521 (18.3%) cases missing.

Table 7. Prevalence of the variables associated with preterm births in singleton livebirths in Ribeirão Preto, 1978–9 and 1994[a].

Variable	1978–9		1994	
	n	%	*n*	%
Occupation group*				
Non-manual workers	1076	17.7	588	21.8
Skilled and semiskilled	3843	61.1	1594	59.0
Unskilled/unemployed	1366	21.7	520	19.2
Not known	461	(6.8)	144	(5.1)
Number of prenatal visits*				
0	489	8.3	75	2.9
1–3	886	15.1	161	6.2
4–6	2207	37.5	549	21.1
$\geqslant 7$	2297	39.1	1812	69.8
Not known	867	(12.9)	249	(8.7)
Maternal age (years)*				
$\leqslant 17$	336	5.0	211	7.4
18 and 19	607	9.1	288	10.1
20–24	2205	33.0	816	28.7
25–29	1939	29.0	754	26.6
30–34	1029	15.4	499	17.7
$\geqslant 35$	565	8.5	271	9.5
Not known	65	0.9	7	(0.3)
Type of hospital*				
Public	6479	96.0	1821	64.0
Private	267	4.0	1025	36.0
Previous abortion(s)				
No	5346	81.6	2331	82.7
Yes	1206	18.4	489	17.3
Not known	194	(2.8)	26	(0.9)
Previous stillbirth(s)				
No	6360	97.1	2756	97.5
Yes	192	2.9	70	2.5
Not known	194	(2.9)	20	(0.7)
Type of delivery*				
Vaginal	4698	69.7	1399	49.2
Caesarean section	2043	30.3	1447	50.8
Not known	5	(0.1)	0	(0.0)
Maternal smoking*				
0	4897	75.8	2247	84.7
1–5	701	10.8	195	7.4
6–10	423	6.5	118	4.4
$\geqslant 11$	444	6.9	92	3.5
Not known	281	(4.1)	194	(6.8)

[a]Percentages calculated excluding missing data. Numbers in parentheses represent percentage of missing data calculated from total.

*Significant $P < 0.001$.

showed a higher risk of preterm deliveries among young teenagers. The increase in the percentage of mothers < 18 years of age over the 15 years was 50%. This increase, although worrying, would have had a minimal impact on the increase in the preterm birth rate.

Mothers who had had a previous abortion and those with previous stillbirths and, to a lesser extent, women from lower social classes had higher rates of preterm births in the main analysis. Several studies have shown an association between preterm delivery and previous history of abortion and stillbirth[8,29] and socio-economic factors.[1,29] There were fewer socially deprived mothers in 1994 than in the previous survey, and the percentages of mothers with previous abortion or stillbirth are very similar in the two surveys. Thus, none of these factors can explain the increase in preterm birth rate over time.

In spite of an increase in the number of antenatal visits in developed countries,[9,20,30] their impact in preventing preterm birth is still controversial.[20] Making prenatal care available to more women and more prenatal visits available to the same women generally does not reduce preterm births.[30] When appropriate adjustment for length of gestation was used for the 1994 cohort, we found that intensive care was significantly related to preterm birth rates. The interpretation of this finding is not straightforward. It is possible that in 1994 obstetricians may have been able to detect women at risk of having a prenatal birth, but they were unable to prevent the event. However, it is also possible that our results were at least in part due to the attributes of the APNCU classification. It is relatively easier to reach the level of care utilisation 'intensive' in the preterm group than in the full-term group. One extra visit of a mother expected to attend six times during pregnancy increases the percentage of utilisation by 17%, whereas an extra visit of a mother who is expected to attend 10 times only increases the percentage of utilisation by 10%.

We collected few clinical data in this study. Goldenberg and colleagues[31] have shown that bacterial vaginosis, fetal fibronectin, cervix length, body mass index below 19.8 and a previous preterm birth are the most important factors associated with a current preterm delivery. Body mass index is unlikely as a factor in increasing preterm births as the current trend has been an increase in obesity. Short cervix is a biological trait that is unlikely to increase suddenly over a short period of time. Data on trends in bacterial vaginosis and fetal fibronectin are not available.

This study was helpful in demonstrating that factors associated with the management of patients around the period of delivery, especially the marked increase in caesarean section over time, may have caused the unprecedented increase of preterm births. Although its

effect on preterm birth rate was small, the marked increase in teenage pregnancy over time is worrying. The only chance of achieving a reduction in the preterm birth rate in Brazil is that health-care staff, particularly those working in private settings, are appropriately educated and audited.

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**denotes person presenting the abstract*

VARIABILITY OF ASD AND VSD PREVALENCE RATES ACROSS STATE BIRTH DEFECT REGISTRIES.

SE Hopkins*, CA Hobbs, CA Fulton (Arkansas Reproductive Health Monitoring System, University of Arkansas for Medical Sciences, Little Rock, AR 72202, USA)

Background. The standardization of state birth defect surveillance systems is needed to improve comparability among state registries. The authors examined the prevalence of atrial septal defects (ASDs) and ventricular septal defects (VSDs) ascertained by the Arkansas Reproductive Health Monitoring System (ARHMS). In comparing the Arkansas prevalence rates to those of other state registries, both active and passive, the authors found marked variability. **Objectives.** To determine the diagnostic certainty of ASD and VSD cases registered in ARHMS, to compare the ASD and VSD prevalence rates in Arkansas and other states, and to identify sources of variability. **Methods.** ASD and VSD cases registered by ARHMS from 1994 through 1996 were reviewed. Sixty percent of the cases were validated. ASD and VSD prevalence rates were compared across registries. **Results.** The prevalence rates of isolated ASD and VSD in Arkansas are 31.6 and 20.3 per 10 000 live births respectively. When compared across state registries, the VSD prevalence rates ranged from 4.6 to 44.2 per 10 000 live births, and ASD prevalence rates ranged from 12.8 to 37.7 per 10 000 live births. Ninety-three percent of the ASD and VSD cases registered in ARHMS had an echocardiogram, surgery or an autopsy to confirm the diagnosis. Possible sources of variability in prevalence rates among state registries include methods of case confirmation, diagnostic inclusion criteria, diagnostic certainty, health care settings monitored, and denominator used. **Conclusions.** State birth defect surveillance systems should consider identifying sentinel birth defects and excluding clinically non-significant malformations from national surveillance. Also, state registries should support greater standardization of birth defect surveillance methods.