Obstetric delivery and risk of neonatal mortality in Goiânia in 2000, Brazil

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Keywords
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Abstract

Objective
To determine factors associated to vaginal delivery and increased neonatal mortality in cohort studies of newborns.
Methods
A retrospective cohort study was carried out using linkage data from the Information System on Live Births and Mortality Data System database, which included all newborns in Goiânia for the year 2000. A stratified analysis of delivery routes and maternity hospitals by risk factors of neonatal mortality was conducted through the calculation of relative risk at a 5% significance level. Statistical analyses were carried out using the Chi-square test at a 5% significance level.
Results
Vaginal deliveries were more commonly seen than cesarean sections in situations where there was an increased risk of neonatal mortality. Public hospitals, where vaginal deliveries predominated, were sought by the majority of those pregnant women with an increased risk of neonatal mortality. Private hospitals, not affiliated to the public-funded Brazilian Healthcare System (SUS) and where the incidence of cesarean section was as high as 84.9%, opted for vaginal delivery in situations of greater risk, such as extreme prematurity and very-low-birth-weight infants.
Conclusions
The association between vaginal delivery and increase neonatal mortality resulted from a selection bias due to the distribution of pregnant women in the hospital network. In addition, this selection bias also resulted from an almost universal preference for cesarean sections in low-risk pregnancies as opposed to vaginal delivery for pregnancies with an increased risk of neonatal mortality.

INTRODUCTION

Scientific knowledge accrued over the years have showed that cesarean section (C-section) increases both maternal and infant disease burden and mortality, as well as health expenditures compared to vaginal delivery. On the other hand, C-section in high risk pregnancies is a valuable medical procedure which, under certain conditions and precise indications, considerably reduces maternal and infant mortality.[14,16]

According to the World Health Organization (WHO), C-section rates should be around 15% to meet the medical indications for surgical interruption of pregnancy. Higher rates could be expected in care centers for high risk pregnancies.[16] However, increasing cesarean rates have been seen worldwide, mostly in developing countries such as Latin American countries, where about 800,000 unnecessary C-sections are performed each year.[1]

In this context, a few Brazilian studies have showed

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increased neonatal mortality in vaginal deliveries when compared to C-sections.[2-4,8] It has been hypothesized that the main causes that can explain this association would be poor quality of care provided to vaginal deliveries and high rates of C-sections in the country.

Two cohort studies on newborns conducted in Goiânia, in 1992 and 2000, have also found a similar association, neonatal mortality in vaginal deliveries was twice as high and 63% higher, respectively, compared to C-sections.[3,8]

The present study aimed at identifying factors involved in the association between neonatal mortality and delivery route and assessing the likelihood of selection of pregnant women as for their delivery route and referral.

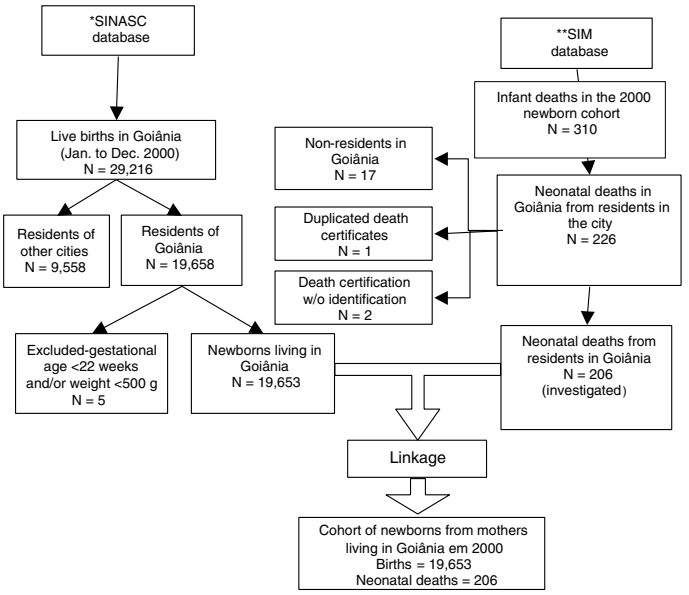

Figure - Database construction of the Goiânia newborn cohort, 2000.

METHODS

Database of the cohort study on newborns carried out in Goiânia, state of Goiás, in the year 2000, obtained from linkage data from birth certificates of the National System of Live Births (SINASC) and death certificates of the Mortality Information System (SIM), provided by the Municipal and State Health Departments, was used in the study. The local monitoring group for neonatal death examined all neonatal deaths in the city,[12] and the main cause of death was therefore reassessed according to the International Classification of Diseases (ICD-10).

The city of Goiânia has a population of 1,093,007 inhabitants, of which 105,100 are children under the age of five. Local neonatal and child mortality rates are 11 and 16 per 1,000 live births, respectively.

Figure 1 shows the database construction and the cases included and excluded. In the makeup of the newborn cohort, all variables of birth certificates were included when information loss was up to 10%. The sole exception was the inclusion of the variable "maternal schooling" that, despite a 10.4% information loss, was included due to its relevance as a socioeconomic indicator. In addition, some variables were heterogeneously distributed among groups with and without information on maternal schooling. Newborn death and age were the sole variables gathered from death certificates included in the study, according to other studies' recommendations due to low quality data found on these certificates.[10]

It was considered as low birth weight (LBW) infants those with a birth weight lower than 2,500 g; as neonatal period the first 28 days of life; and as preterm infants those born with less than 37 weeks' gestation. Hospitals were categorized into public, private not affiliated with the Brazilian Healthcare System (non-SUS private) and private affiliated with the SUS (SUS-private), according to the Goiás State Health Department and the Brazilian Ministry of Health Hospital Information System (HIS) hospital registries. The public hospital category included three public state maternity hospitals, a local public maternity hospital, a university maternity hospital, and a charity hospital. Although according to HIS a charity hospital should be categorized as a SUS-private hospital, it was included under the public hospital category given that its clientele and care provided were similar to those of public hospitals, besides having medical residence programs and internships. The SUS-private hospital category comprised 16 hospitals and the non-SUS private hospital category comprised six hospitals.

The association between delivery route and neonatal mortality was assessed through stratified analysis by delivery route and hospital of birth according to variables collected from birth certificates and referred in the literature as risk factors of neonatal mortality. In the stratified analysis by delivery route, the delivery route was considered the dependent variable and gestational age, birth weight, hospital of birth, prenatal visits, maternal schooling, and mother's living area were considered independent variables. In the stratified analysis by hospital of birth, the dependent variable was hospital of birth and the independent variables were infant death, delivery route,

gestational age, birth weight, birth defects, maternal schooling, mother's living area and prenatal visits. Relative risks as well as confidence intervals were estimated for the associations found at a 5% significance level. Statistical validation was carried out using the Chi-square test at a 5% significance level.

Fox Pro 6.0, Epi Info 6.04 and SPSS 10.1 softwares were used in the database construction, data analysis and statistical validation. The study was approved by the Research Ethics Committees of Faculdade de Medicina da Universidade Federal de Goiás and the Universidade Federal de Minas Gerais.

RESULTS

The cohort analysis demonstrated that, in the year 2000, there were reported 29,216 live births, of which 19,658 from pregnant women living in the city of Goiânia. Of a total of 310 infant deaths, 206 were neonatal. Neonatal, early neonatal and late neonatal mortality rates were as follows: 10.5, 6.9 and 3.6 per 1,000 live births, respectively. Also, LBW occurred in 6.9%, prematurity 5.5%, teenager mothers 21.5%, twin pregnancies 2.2% and birth defects 0.4%. Only 0.8% of the mothers had no schooling and 1.0% did not attend any prenatal visits. In 99.8% of the pregnancies, delivery took place in a hospital setting, most of them in SUS-public hospitals. C-section rates were 56%.

The stratified analysis by delivery route included the following variables: gestational age, birth weight, hospital of birth, prenatal visits, maternal schooling and mother's living area. It showed that vaginal deliveries outnumbered C-sections in pregnancies with increased risk for neonatal mortality. Vaginal deliveries were about four times more common in public hospitals compared to non-SUS private hospitals and 24% compared to SUS-private hospitals (Table 1).

Table 2 shows the stratified analysis by hospital of birth according to the following variables: maternal schooling, prenatal visits, maternal age, infant death, delivery route, gestational age, birth weight, birth defects and mother's living area. It is worth noting that 95 (46.5%) infant deaths were seen in public hospitals, which had higher rates of vaginal deliveries compared

Table 1 - Stratification by delivery routes according to risk factors for neonatal mortality. Goiânia, 2000.

Variables	Delivery route				RR	CI
	Vaginal		C-section			
	N	%	N	%		
Gestational age[a]						
22-27 weeks	41	80.4	10	19.6	1.85	(1.61-2.12)
28-31 weeks	71	51.1	68	48.9	1.18	(1.00-1.18)
32-36 weeks	416	44.3	524	55.7	1.02	(0.95-1.10)
37-41 weeks*	7,610	43.4	9,910	56.6	1	
≥42 weeks	277	57.5	205	42.5	1.32	(1.22-1.43)
Birth weight[b]						
500-999	30	65.2	16	34.8	1.46	(1.18-1.81)
1,000-1,499	72	58.1	52	41.9	1.3	(1.12-1.51)
1,500-1,999	123	44.4	154	55.6	1.0	(0.87-1.14)
2,000-2,499	421	46.8	478	53.2	1.05	(0.98-1.13)
2,500-3,999*	7,678	44.5	9,554	55.5	1	
≥4.000	281	28.4	710	71.6	0.64	(0.58-0.70)
Hospital of birth[c]						
Public*	2,184	61.9	1,344	38.1	1	
SUS-private	694	15.1	3,908	84.9	0.24	(0.23-0.26)
Non-SUS private	5,728	49.9	5,744	50.1	0.81	(0.78-0.83)
Prenatal visit[d]						
None	142	76.8	43	23.2	1.96	(1.81-2.13)
1-3	559	71.1	227	28.9	1.82	(1.73-1.91)
4-6	2,004	58.6	1,417	41.4	1.5	(1.45-1.55)
≥7*	5,223	39.1	8,128	60.9	1	
Maternal schooling[e]						
None	90	65.2	48	34.8	2.29	(2.01-2.62)
1-3 years	685	58.5	486	41.5	2.04	(1.92-2.20)
4-8 years	3,380	56.4	2,609	43.6	1.99	(1.88-2.09)
9-11 years	2,479	40.5	3,649	59.5	1.42	(1.34-1.51)
≥12 years*	1,184	28.4	2,981	71.6	1	
Maternal age[f]						
<20 years	2,543	61	1,627	39.0	1.5	(1.45-1.55)
20-34 years*	5,740	40.7	8,355	59.3	1	
≥35 years	254	22.1	894	77.9	0.5	(0.49-0.61)
Mother's living area[g]						
Northwest region	1,410	57.4	1,045	42.6	1.37	(1.32-1.42)
Other regions*	7,136	41.9	9,876	58.1	1	

Excluded due to unknown information: (a) 521 (2.7%) gestational age and/or delivery route, (b) 84 (0.4%) birth weight and/or delivery route, (c) 59 (0.3%) hospital of birth and/or delivery route, (d) 1,910 (9.7%) prenatal visit and/or delivery route, (e) 2,062 (10.5%) maternal schooling and/or, (f) 240 (1.2%) maternal age and/or delivery route and (g) 186 (0.94%) mother's living area and/or delivery route

*Reference categories for estimating the relative risk (RR)

to C-sections. Also, they had higher prematurity, LBW, birth defects, teenager mothers. Mothers living in the Northeast area with no schooling and who did not attend any prenatal visits were all factors associated to increased neonatal mortality. Table 2 also shows the relative risk (RR) of the associations found between the different categories of hospital of birth, as well as confidence intervals and p-value.

Table 3 shows the stratified analysis by hospital of birth according to gestational age and birth weight. It can be noted that extreme prematurity and very-low-birth-weight infants were more frequently seen in public hospitals.

While analyzing delivery route by hospital of birth according to birth weight, it was noted that, in public and SUS-private hospitals, vaginal deliveries rates were similar to those of C-sections for low-weight infants having between 2,500 and 2,999 g. On the other hand, in similar circumstances, in non-SUS private hospitals, vaginal deliveries compared to C-section rates were inversely proportional to birth weight: the lower the birth weight, the higher the vaginal delivery rates. Similar findings were seen while analyzing delivery route by hospital of birth according to gestational age in non-SUS private hospitals: the lower the gestational age, the higher the vaginal delivery rates (Table 4).

DISCUSSION

The major contribution of the present study was to show how selection bias can produce misleading results and thus entice flawed conclusions in retrospective cohort studies. A stronger association between vaginal delivery and neonatal mortality had been already described in another Goiânia study conducted in 1992.[8] The same association was verified by Gotlieb & Sousa[2] in Maringá in 1993 and by Flores[4] in the state of São Paulo in 1999. The 2000 newborn cohort study of Goiânia, which provided the database for the present study analysis, has also found increased neonatal mortality associated to vaginal deliveries.[3] Both in this study and in Morais[8] study, the association between vaginal delivery and neonatal mortal-

Table 2 - Stratification by hospital of birth according to risk factors for neonatal mortality. Goiânia, 2000.

Categories of hospital of birth	Variables										RR	CI
	N	%	N	%	N	%	N	%	N	%		
Maternal schooling[a]	None*		1-3 years		4-8 years		9-11 years		≥12 years*			
Public hospital	40	1.2	306	8.9	1,595	46.1	1,260	36.4	256	7.4	1	
Non-SUS private hospital	12	0.3	101	2.6	416	10.6	1,656	42.3	1,733	44.2	0.05	(0.03-0.10)
SUS-private hospital	83	0.8	760	7.4	3,978	39.0	3,212	31.5	2,179	21.3	0.27	(0.19-0.39)
Prenatal visit[b]	None*		1-3 visits		4-6 visits		≥7 visits*					
Public hospital	104	3.1	378	11.2	1,288	38.0	1,618	47.8			1	
Non-SUS private hospital	8	0.2	18	0.5	115	3.0	3,670	96.3			0.04	(0.02-0.07)
SUS-private hospital	68	0.6	386	3.7	2,014	19.1	8,074	76.6			0.14	(0.10-0.19)
Maternal age[c]	<20 years		20-34 years*		≥35 years							
Public hospital	914	26.0	2,448	69.6	154	4.4					1	
Non-SUS private hospital	423	9.6	3,562	78.4	557	12.3					0.39	(0.35-0.43)
SUS-private hospital	2,837	25.0	8,085	71.2	432	3.8					0.96	(0.90-1.02)
Death	Yes		No									
Public hospital	95	2.7	3,438	97.3							1	
Non-SUS private hospital	43	0.9	4,559	99.1							0.35	(0.24-0.50)
SUS-private hospital	66	0.6	11,424	99.4							0.21	(0.16-0.29)
Delivery route[d]	Vaginal		C-section									
Public hospital	2,185	61.9	1,344	38.1							1	
Non-SUS private hospital	693	15.1	3,900	84.9							0.24	(0.23-0.26)
SUS-private hospital	5,728	49.9	5,744	50.1							0.81	(0.78-0.83)
Gestational age[e]	<37 weeks		≥37weeks									
Public hospital	426	12.3	3,024	87.7							1	
Non-SUS private hospital	279	6.1	4,238	92.1							0.5	(0.43-0.58)
SUS-private hospital	423	3.7	10,740	93.5							0.31	(0.27-0.35)
Birth weight[f]	<37 weeks		≥37 weeks									
Public hospital	489	13.9	3,017	86.1							1	
Non-SUS private hospital	300	6.5	4,297	93.5							0.47	(0.41-0.54)
SUS-private hospital	554	4.8	10,915	95.2							0.35	(0.31-0.39)
Birth defects[g]	Yes		No									
Public hospital	23	0.8	3,032	99.2							1	
Non-SUS private hospital	20	0.5	4,292	99.5							0.62	(0.34-1.12)
SUS-private hospital	29	0.3	10,328	99.7							0.37	(0.22-0.64)
Mother's living area[h]	Northwest		Others									
Public hospital	534	15.3	2,966	84.7							1	
Non-SUS private hospital	126	2.8	4,454	97.2							0.18	(0.15-0.22)
SUS-private hospital	1,795	15.8	9,593	84.2							1.03	(0.95-1.13)

Excluded due to unknown information: (a) 2,066 (10.5%) maternal schooling and/or hospital of birth, (b) 1,912 (9.7%) prenatal visit and/or hospital of birth, (c) 238 (1.2%) maternal age and/or hospital of birth, (d) 59 (0.3%) delivery route and/or hospital of birth, (e) 523 (2.7%) gestational age and/or hospital of birth, (f) 81 (0.4%) birth weight and/or hospital of birth, (g) 1,929 (9.8) birth defects and/or hospital of birth, (h) 185 (0.94%) mother's living area and/or hospital of birth.
*Reference categories for estimating relative risk

ity found in the univariate analysis has been confirmed in the logistic regression analysis. Only the stratified analysis by delivery route and hospital of birth according to risk factors for neonatal mortality allowed to ascertain that such an association derived from selection bias. It resulted from the distribution of pregnant women in the local hospital network and hospital preferences of delivery route in pregnancies with increased risk of neonatal mortality. In the city of Goiânia, vaginal deliveries were the preferred option in most pregnancies with increased risk of neonatal mortality and C-sections were nearly the sole option for low-risk pregnancies.

The stratification by hospital of birth according to variables associated to neonatal mortality showed higher neonatal mortality in public hospitals, which could be partially explained by factors such as prematurity, LBW, birth defects, lower mother schooling, and more pregnant women who did not attend any prenatal visits and came from the Northeast city area. The Northeast area of the city Goiânia is a geographically well-defined zone, mostly inhabited by low income population and known to have higher rates of teenage mothers, LBW infants and higher infant mortality.[8] In addition, the analysis by hospital of birth according to gestational age and birth weight showed that, besides higher prematurity and LBW infants, public hospitals had higher extreme premature and very-low-birth-weight infants. LBW and premature infants at these hospitals had more severe health conditions than those seen in the other hospital categories.

The stratified analysis by delivery route and hospital of birth has evidenced that high-risk pregnant women for neonatal mortality were mostly cared at public hospitals, where vaginal deliveries were for the most part performed. In contrast, there seems to have selection of pregnant women seen at public and SUS-private hospitals, since the latter category showed lower neonatal mortality, prematurity, LBW infants and birth defects, even though they provided care to a similar population to that of public hospitals of teenage mothers coming from the Northeast city area. If SUS-private hospitals actually provide care to low-risk pregnant women, then a 32.4% infant death and 6 per 1,000 live births neonatal mortality rate can be therefore regarded as relatively high.

The 56% C-section rate found in the study is very high even bearing in mind that these rates have considerably increased in the last decades worldwide.[6,13,17] Belizán et al[1] notes that, among 12 leading countries in C-sections, Brazil has ranked second (32%), fol-

Table 3 - Stratification by hospital of birth according to gestational age and birth weight. Goiânia, 2000.

Categories of hospital of birth	Variables											
	N	%	N	%	N	%	N	%	N	%	RR	CI
Maternal schooling[a]	None*		1-3 years		4-8 years		9-11 years		≥12 years*			
Public	40	1.2	306	8.9	1,595	46.1	1,260	36.4	256	7.4	1	
Non-SUS private	12	0.3	101	2.6	416	10.6	1,656	42.3	1,733	44.2	0.05	(0.03-0.10)
SUS private	83	0.8	760	7.4	3,978	39.0	3,212	31.5	2,179	21.3	0.27	(0.19-0.39)
Prenatal visits[b]	None*		1-3		4-6		≥7*					
Public	104	3.1	378	11.2	1,288	38.0	1,618	47.8			1	
Non-SUS private	8	0.2	18	0.5	115	3.0	3,670	96.3			0.04	(0.02-0.07)
SUS private	68	0.6	386	3.7	2,014	19.1	8,074	76.6			0.14	(0.10-0.19)
Maternal age[c]	<20 years		20-34 years*		≥35years							
Public	914	26.0	2,448	69.6	154	4.4					1	
Non-SUS private	423	9.6	3,562	78.4	557	12.3					0.39	(0.35-0.43)
SUS private	2,837	25.0	8,085	71.2	432	3.8					0.96	(0.90-1.02)
Death	Yes		No									
Public	95	2.7	3,438	97.3							1	
Non-SUS private	43	0.9	4,559	99.1							0.35	(0.24-0.50)
SUS private	66	0.6	11,424	99.4							0.21	(0.16-0.29)
Delivery route[d]	Vaginal		C-section									
Public	2,185	61.9	1,344	38.1							1	
Non-SUS private	693	15.1	3,900	84.9							0.24	(0.23-0.26)
SUS private	5,728	49.9	5,744	50.1							0.81	(0.78-0.83)
Gestational age[e]	<37 weeks		≥37 weeks									
Public	426	12.3	3,024	87.7							1	
Non-SUS private	279	6.1	4,238	92.1							0.5	(0.43-0.58)
SUS private	423	3.7	10,740	93.5							0.31	(0.27-0.35)
Birth weight[f]	<37 weeks		≥37 weeks									
Public	489	13.9	3,017	86.1							1	
Non-SUS private	300	6.5	4,297	93.5							0.47	(0.41-0.54)
SUS private	554	4.8	10,915	95.2							0.35	(0.31-0.39)
Birth defects[g]	No		Yes									
Public	23	0.8	3,032	99.2							1	
Non-SUS private	20	0.5	4,292	99.5							0.62	(0.34-1.12)
SUS private	29	0.3	10,328	99.7							0.37	(0.22-0.64)
Mother's living area[h]	Northeast		Others									
Public	534	15.3	2,966	84.7							1	
Non-SUS private	126	2.8	4,454	97.2							0.18	(0.15-0.22)
SUS private	1,795	15.8	9,593	84.2							1.03	(0.95-1.13)

Excluded due to unknown information: 133 (3.0%) gestational age and/or hospital of birth and/or birth weight.

Table 4 - Stratification by hospital of birth according to delivery route, gestational age and birth weight. Goiânia, 2000.

	Public hospital				Non-SUS private hospital				SUS-private hospital			
	Vaginal		C-section		Vaginal		C-section		Vaginal		C-section	
	N	%	N	%	N	%	N	%	N	%	N	%
Gestational age												
22-27 weeks	30	88.2	4	11.8	5	50	5	50.0	6	85.7	1	14.3
28-31 weeks	48	64.9	26	35.1	5	16.1	26	83.9	18	52.9	16	47.1
32-36 weeks	185	58.2	133	41.8	46	19.3	192	80.7	183	47.9	199	52.1
37-41 weeks	1,831	61.9	1,126	38.1	622	14.8	3,587	85.2	5,137	49.7	5,147	50.3
≥42 weeks	34	53.1	30	46.9	1	4.3	22	95.7	239	61.1	152	38.9
Birth weight												
500-999 g	20	71.4	8	28.6	7	53.8	6	46.2	2	50.0	2	50.0
1.000-1.499 g	53	71.6	21	28.4	3	12.5	21	87.5	16	61.5	10	38.5
1.500-1.999 g	66	58.6	46	41.1	8	11.6	61	88.4	47	50.0	47	50.0
2.000-2.499 g	152	55.3	123	44.7	36	18.6	158	81.4	232	54.1	197	45.9
2.500-2.999 g	598	68.6	274	31.4	184	19.0	784	81.0	1,351	55.5	1,083	44.5
3.000-3.499 g	865	64.9	467	31.1	311	15.6	1,686	84.4	2,551	50.9	2,461	49.1
3.500-3.999 g	354	54.1	300	45.9	122	11.1	977	88.9	1,319	46.4	1,524	53.6
≥4.000 g	60	38.5	96	61.5	20	8.9	205	91.1	201	33.0	408	67.0

Excluded 707 (3.6%) due to unknown information on hospital of birth and/or delivery route and/or gestational age and/or birth weight.

lowed by Chile (40%). It should be stressed that increasing C-section rates in most countries have not been paralleled by a comparable reduction in neonatal mortality rates – a common reasoning used to justify such widespread practice.

Another point to be concerned about is the likely selection in the preferred delivery route in non-SUS private hospitals in pregnancies with increased risk of neonatal mortality. In these hospitals, the higher gestational age and birth weight the more C-sections performed. Vaginal deliveries were 4.83 times more common than C-sections in the birth weight between 500 and 999 g when compared to birth weight between 2,500 and 2.999 g and even 3.38 times more common in the gestational age 22-27 weeks when compared to 37-41 weeks. Similar rates were not verified in other hospital categories. Thus, it has been evidenced that C-sections were nearly universally performed in low-risk pregnancies, and vaginal deliveries were restricted to pregnancies with increased risk of neonatal mortality, such as extreme prematurity and very-low-birth-weight.

Several studies have reported the impact of population socioeconomic status on C-section rates.[7,13,14,17] In Brazil, some authors have described a relationship between pregnant women's socioeconomic status and C-sections rates.[7,13,15,17] In a Pelotas study, Victora et al[15] have observed that population socioeconomic status is not only associated to C-sections but also to induction of labor, which was found to be higher among those with lower socioeconomic status. In a Ribeirão Preto study, C-section rates ranged according to the category of hospital coverage, either public or private. Not only C-sections were twice as high in private patients compared to public patients but also these rates were increasingly higher as pregnant women's social condition increased.[17]

The results of the present study point out to the effect of non-medical aspects in determining high C-section rates in Goiânia. C-section rates found in public and SUS-private hospitals of 38.1% and 50.1%, respectively, are high above the WHO recommended 15% rate. It is a matter of concern C-section rates as high as 84.9% seen in non-SUS private hospitals. While non-SUS private hospitals provided care to pregnant women with higher schooling, who attended more prenatal visits and came from better-off city areas, higher rates of vaginal deliveries were seen in public hospitals that cared to less privileged pregnant women. This finding shows that, inconsistently, C-sections have been more often performed in low-risk pregnancies and vaginal deliveries have been preferred in pregnancies with increased risk of neonatal mortality. A similar distortion has been demonstrated by other authors who also found high C-sections rates.[7,12,17]

It is likely that not only socioeconomic characteristics have an effect on high C-section rates found in all hospital categories in this city. The literature has described several factors affecting C-section rates, among them, pay for delivery care, culture and, above all, the organizational structure of hospital care.[9,11,15] Delivery care provided by public hospitals in Goiânia often follows a schedule of doctor's shifts, which might has facilitated the choice for vaginal deliveries. In contrast, care to pregnant women who have private health insurance or other contracted insurance plans is provided in many different hospitals by their prenatal care doctor, which impairs delivery care since these doctors have to put off all their other tasks in order to attend their patients in labor. SUS-private hospitals, on the other hand, operate by certain SUS restrictions and cannot exceed a set rate of C-sections.

Though no direct association between high C-sec-

tion rates and neonatal mortality was found in the study hospitals, which might be explained by the biases mentioned before, such high rates constitute a considerable expenditure of resources which otherwise could be employed in other aspects of perinatal care.

The hypothesis that biases might have affected the association between vaginal deliveries and neonatal mortality found in Goiânia cohort studies has been formulated based on entirely conflicting knowledge accrued in the literature and on the authors' knowledge in regard to the structure of perinatal care delivered in the city. Hence, it was realized that using data from the SINASC and SIM in population-based cohort studies is feasible when information from birth and death certificates is critically appreciated.

The study results indicate a need for redirecting health policies and focusing on public hospitals as they provide care to population with increased risk of neonatal mortality. In addition, further investigation is needed to improve knowledge on high C-section rates and to evaluate the access and quality of perinatal care in public services, especially that delivered to high-risk pregnant women, as well as to determine the quality of care provided in vaginal deliveries.

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