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Increase in preterm births in Brazil: review of population-based studies

ABSTRACT

OBJECTIVE: The greatest cause of infant mortality in Brazil is perinatal conditions, mostly associated with preterm delivery. The objective of the study was to evaluate the evolution of preterm delivery rates in Brazil.

METHODS: A review was conducted using the Medline and Lilacs databases, including published studies in periodicals, thesis and dissertations since 1950. Exclusion criteria were: studies related to clinical trials and those with complications at gestation and preterm delivery and care. Inclusion criteria were: population-based studies on prevalence of preterm delivery in Brazil, with representative sample of the studied population, and using primary data. Out of 71 studies found, analysis was carried out on 12.

RESULTS: The prevalence of preterm delivery found ranged from 3.4% to 15.0% in the Southern and Southeastern regions between 1978 and 2004, with a rising trend from the 1990s onwards. Studies in the Northeastern region between 1984 and 1998 found prevalences of preterm delivery ranging from 3.8% to 10.2%, also with a rising trend.

CONCLUSIONS: Data from the national live birth information system do not corroborate these trends. Rather, they show differences between the preterm rates given by this system and the rates measured in the studies included in this review. Because of the important role of preterm birth in relation to infant mortality in Brazil, it is important to identify the cause of these increases and to plan interventions that can diminish their occurrence.

DESCRIPTORS: Premature Obstetric Labor, epidemiology. Data Sources. Perinatal Mortality. Infant Mortality. Review Literature as Topic. Brazil.

INTRODUCTION

In 1996, perinatal causes were responsible for 49.7% of infant mortality in Brazil, and they increased to 53.6% and 55.4% in 2000 and 2003, respectively.^a This increase in proportional mortality was present in all regions of the country. However, the estimated national coefficient of infant mortality (CIM) due to perinatal causes had reduced from 29.0 to 21.3 per thousand between the periods 1985-87 and 1995-97.²¹ In 2004, combination of the infant mortality estimate of 26.7 per thousand^b from the *Instituto Brasileiro de Geografia e Estatística* (IBGE, Brazilian Institute for Geography and Statistics)

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Received: 7/23/2007
Reviewed: 2/18/25008
Approved: 4/8/2008

^a Ministério da Saúde. Saúde Brasil 2005: uma análise da situação de saúde. Brasília; 2005. (Série C. Projetos, Programas e Relatórios)

^b Instituto Brasileiro de Geografia e Estatística. Indicadores Sociodemográficos Prospectivos para o Brasil 1991-2030. Projeto UNFPA/Brasil (BRA/02/P02). Rio de Janeiro; 2006.

with the proportional infant mortality due to perinatal causes (57%^a) made it possible to estimate a CIM due to perinatal causes that was even lower, of 15.2 per thousand. The coefficients were higher in the north and northeast, and lower in the south and southeast. The reason for this increase may be that the reduction in this group of causes was slight over the last decade, while other causes of death among children under one year of age declined markedly. Certain programs and actions implemented in this country have contributed towards the decline in postneonatal infant mortality. Among these actions, the following can be cited: stimulation for maternal breastfeeding, immunizations, oral rehydration therapy, increased coverage of health services and expansion of basic sanitation, among others. However, further reductions in infant mortality are largely going to depend on achieving an effective impact on perinatal causes.²¹

Among the perinatal causes of infant mortality, 61.4% are associated with preterm birth, such as respiratory distress syndrome, hypoxia and other respiratory problems. Thus, preterm birth plays an important role in relation to infant mortality and therefore adequate control and management of preterm birth become potentially effective interventions for reducing this mortality.²¹

Although progressive improvements in the coverage and quality of the data in the live birth information system (*Sistema de Informações de Nascidos Vivos, SINASC*) have been occurring throughout Brazil, problems still exist regarding the accuracy of some specific indicators (Ministry of Health^b 2005). Among these is the gestational age. Brazilian studies investigating the reliability of the gestational age furnished by SINASC through comparison with data collected in surveys have found kappa index values ranging from 0.09 to 0.83, with a proportion of unknown values of the order of 10% to 12.4%.^{18,20} The prevalence of preterm births tends to be underestimated, especially because of classification errors among preterm newborns of gestational age between 34 and 36 weeks, such that they are wrongly classified as full-term.²⁰ This makes it difficult to adequately estimate the prevalence of preterm births in Brazil through the use of secondary data.

The present study had the aim of evaluating the evolution of preterm birth rates in Brazil that have been reported from investigations conducted using primary data collected from population-based samples.

STUDY SELECTION METHOD

A bibliographic search was performed in the Medline and Lilacs databases. The keyword combinations used

were: (premature/preterm and Brazil); (premature/preterm delivery and Brazil); (premature/preterm infant and Brazil); (premature/preterm labor and Brazil); (risk factors and premature/preterm delivery and Brazil); (risk factors and premature/preterm labor and Brazil); (associated factors and premature/preterm labor and Brazil); (associated factors and premature/preterm delivery and Brazil); (incidence and premature/preterm labor and Brazil); (prevalence and premature/preterm labor and Brazil); (incidence and premature/preterm delivery and Brazil); (prevalence and premature/preterm delivery and Brazil). This search was limited to the time for which the databases have existed (Medline since 1950 and Lilacs since 1981). The search included all the articles published in periodicals, dissertations and theses.

Among the articles that were identified, the ones that related to clinical topics such as complications of preterm births and pregnancy and caring for preterm newborns were excluded. The inclusion criteria were that the articles should be on the prevalence of preterm births using Brazilian data, with representative samples from the study locations and primary data. Studies were considered to have representative samples if they included all the births in hospitals that occurred in the locality over a given period, or if they used a probabilistic process to select a sample of newborns in hospitals. Deliveries at home are rare in the urban centers where these studies were conducted.

From the Medline database, 71 references were obtained and read. Of these, 50 were discarded in accordance with the exclusion criteria described above. Among the remaining 21, 10 were original studies and the other 11 were excluded because they repeated results within the same database.

Twenty references were identified in the Lilacs database. Out of 19 that were obtained, 14 were discarded because they did not relate to population-based samples and five were included (three articles, one dissertation and one thesis).

All the references cited in the selected papers (and even those in the discarded papers) were examined. Fifteen were selected, of which nine were discarded because they did not relate to population-based samples, thus resulting in the inclusion of six references. In total, 21 references were selected (ten from Medline, five from Lilacs and six cited in other articles). Of these, 12 were included for study, of which ten were articles published in periodicals, one was a doctoral thesis and one was a master's dissertation. The nine references that were discarded used secondary data from SINASC. The methodology used in the included studies was of cohort type in seven cases and cross-sectional in five cases.

^a Ministério da Saúde. Informações de saúde. Estatísticas Vitais - Mortalidade e Nascidos Vivos. Brasília; [s.d.]. [cited 2008 Aug 22] Available from: <http://w3.datasus.gov.br/datasus/datasus.php?area=359A1B378C5D0E0F359G22H1Jd5L25M0N&VInclude=../site/infsaude.php>

^b Ministério da Saúde. Saúde Brasil 2005: uma análise da situação de saúde. Brasília; 2005. (Série C. Projetos, Programas e Relatórios)

The Table shows the references that were identified, with regard to the date of the study and the location where it was conducted, its design, the population studied, the definition of preterm birth and the prevalence of this outcome. All these studies classified newborns as preterm if their gestations lasted for less than 37 weeks. In the following, the studies are presented in sequence of their date of publication. No population-based studies conducted in the northern or central-western regions of Brazil were found.

RESULTS FROM THE STUDIES REVIEWED

In Natal (Northeastern Brazil), Gray et al¹⁰ conducted an analysis of cases and controls through a cross-sectional study on single births in five hospitals between September 1984 and February 1986. Data on 11,171 newborns were collected, which represented around 71% of all of the births from women living in Natal (births in hospitals, at all of the hospitals in the city, represented 90.2% of all births). The prevalence of preterm births was 3.8% (429 infants), and no association between this event and socioeconomic status was found.

The doctoral thesis of Rumel^a included all the live births from mothers living in Bauru (Southeastern Brazil) between May 11, 1986, and November 10, 1987. The aim of the study was to evaluate the capacity of clinical and social factors that were easily obtainable at the time of delivery to predict mortality among children aged zero to six months. Among the 6,989 children studied, the prevalence of preterm birth was 3.4%. The author did not report the methodology used to define the gestational age.

Barros et al,² in a cohort study conducted on 5,914 live births in Pelotas (Southern Brazil) in 1982, found that the prevalence of low birth weight was 9.0%, preterm birth was 6.3% and intrauterine growth restriction (IUGR) was 9.0%. In their study, 62% of the newborns with low birth weight presented IUGR and 36% were preterm. Preterm birth was significantly associated with low pre-gestational weight and extreme ages among the mothers.

In a master's dissertation, Oliveira^b investigated the association between the type of work performed by the mother during pregnancy and occurrences of diseases, delivery complications and preterm birth. This study was conducted in Recife (Northeastern Brazil) between December 1990 and April 1991, among 561 puerperae living in that city who were selected randomly from six maternity hospitals in the city. The author did not report the proportion of the deliveries in Recife that took place in those maternity hospitals.

The prevalence of preterm births that was found was 10.2%. Gestational age was assessed using Capurro's method⁷ and physical examination, by the hospital's clinical staff. There was no significant association between preterm birth and the type of work performed by the mother during pregnancy. Women with low levels of schooling who were performing informal work presented higher frequency of all the events investigated (diseases, complications and preterm birth). Work in which standing up was required was more frequently associated with preterm birth, with an association measurement of 2.73 (95% CI: 1.08; 6.90).

Horta et al¹¹ found a prevalence of preterm births of 7.5% in another cohort of 5,249 live births in Pelotas (Southern Brazil) in the year 1993. Family income was inversely associated with low birth weight and IUGR, but not with preterm birth. These authors also indicated that, despite improvements in socioeconomic situation and maternal nutrition, there were increases in low birth weight, IUGR and preterm birth between the 1982 and 1993 cohorts: respectively, from 9% to 9.8%, 15% to 17.5% and 5.6% to 7.5%.

Bettiol et al⁵ described the results found in two cohort studies on live births from single deliveries in hospitals in the city of Ribeirão Preto (Southeastern Brazil): the first between June 1978 and May 1979 (6,681 births) and the second between May and August 1994 (3,579 births). Information on gestational age was available for 75% and 82% of the cases, respectively. The authors did not report the methodology used to define gestational age. The prevalence of preterm births was 6% (cohort of 1978-79) and 13.3% (cohort of 1994), with a statistically significant increase ($p < 0.001$) from the first to the second study. The positive changes between the two cohorts included increased coverage of prenatal care and schooling levels among the mothers, and decreased smoking during pregnancy. On the other hand, there were increases in the rates of teenage pregnancy, cesarean sections and low birth weight. The increase in the latter indicator from 1978-79 to 1994 was greater among families with occupations of higher qualification level, occurring only for children born at gestational ages of 36-40 weeks, with birth weights between 1.5 and 2.49 kg, i.e. among children who were more likely born from elective cesarean section.

In a cross-sectional study conducted in São Luis (Northeastern Brazil) between March 1997 and February 1998, Silva et al¹⁹ analyzed a systematic sample of 2,831 births that took place in hospitals, stratified according to the ten maternity hospitals and proportional to the number of births in each hospital. These authors found that the prevalence of preterm birth was 13.9% and the prevalence of low birth weight was 9.6%.

^a Rumel D. Acurácia dos critérios de risco do Programa de Defesa da Vida dos Lactentes do Município de Bauru entre 1986 e 1988 [doctoral thesis]. São Paulo: Faculdade de Saúde Pública da USP; 1989.

^b Oliveira MT. A saúde da mulher trabalhadora: estudo da relação entre trabalho na gestação e a ocorrência de doenças, complicação do parto e recém-nascidos prematuros na cidade do Recife, PE [master's dissertation]. Salvador: Universidade Federal da Bahia; 1992.

Table. Characteristics of the preterm birth prevalence studies in Brazil that were included in this review.

Author	Location	Period	Design	Sample (N, selection criterion, % of births)	Definition of preterm	Prevalence of preterm births [95% CI]	Methodological strengths and weaknesses
Rumel*	Bauru	1986-87	Cohort	6989, LB, 100%	Not mentioned	3.4%	Information on preterm birth, congenital malformation and birth weight from medical files; other variables from interviews.
Gray et al ¹⁰	Natal	1984-86	Cross-sectional with nested case-control	11171, LB, 71%	Capurro	3.8%	Good level of information on incidence and determinants of perinatal death; risk factors (birth weight and GA).
Oliveira**	Recife	1990-91	Cross-sectional	561, puerperae, sample	Capurro, DLM, physical examination	10.2% [7.5;12.5]	Outcome not well standardized: examination performed by hospital's clinical staff, and not always Capurro. Low power for detecting significant associations: few participants per work category.
Barros et al ²	Pelotas	1982	Cohort	5914, LB, 99%	DLM	6.3%	Recruited almost 100% of the study population; discussed risk factors for IUGR and preterm birth; GA unknown in 21% of the cases.
Horta et al ¹¹	Pelotas	1993	Prospective cohort	5249; LB, 99% of deliveries	DLM	7.5%	Recruited almost 100% of the study population; discussed the prevalence of LBW and differences between the cohorts.
Bettiol et al ⁵	Ribeirão Preto	1978-79; 1994	Cohorts	1978-79: LB, 6681, 96% 1994: 3579, LB, ≈30%	Not mentioned	78/79: 6.0% 1994: 13.3%	GA available for 75.4% (1978-79) and 81.7% (1994). Information on preterm birth: losses of 17.4%.
Nascimento ¹⁴	Taubaté	1999	Cohort, hospital-based	589, puerperae, sample	Estimated by neonatologist	11.9% [9.3;23.8]	Indicated sociodemographic and medical factors relating to preterm delivery; use of GA estimated by physicians may increase the reliability of these data; wide CI.
Silva et al ¹⁹	São Luis	1997-98	Cross-sectional	2831, LB, sample	DLM	13.9% [12.7;15.3]	Compared the study data with SINASC data, finding low concordance for preterm birth data; indicated possible reasons for this difference.
Rondo et al ¹⁶	Jundiaí	1997-2000	Longitudinal cohort	865, pregnant women in prenatal period, sample	Combination of USG up to 20 weeks, Capurro and DLM	4.2% [2.7;5.3]	Losses: 27%.
Almeida et al ¹	Campinas	2001-02	Cross-sectional	248, puerperae, sample	Not mentioned	11.3% [7.3;14.7]	Data on pregnant mothers and evaluation of the quality of prenatal care.
Lunardelli & Peres ¹³	Itajaí	2003	Cross-sectional, population-based	449, parturients, sample	Not mentioned	7.1% [2.3; 9.4]	Possible association between periodontal disease and preterm birth/LBW.

LB: live births; DLM: date of last menstruation; USG: ultrasonography; LBW: low birth weight; IUGR: intrauterine growth restriction; GA: gestational age
 * Rumel D. Acurácia dos critérios de risco do Programa de Defesa da Vida dos Lactentes do Município de Bauru entre 1986 e 1988 [doctoral thesis]. São Paulo: Faculdade de Saúde Pública da USP; 1989.

** Oliveira MT. A saúde da mulher trabalhadora: estudo da relação entre trabalho na gestação e a ocorrência de doenças, complicação do parto e recém-nascidos prematuros na cidade do Recife, PE [master's dissertation]. Salvador: Universidade Federal da Bahia; 1992.

Nascimento¹⁴ conducted a hospital-based cohort study in Taubaté (Southeastern Brazil) on a sample of 589 mothers who gave birth between May 1 and October 31, 1999. The gestational age was evaluated by neonatologists, but the author did not report the methodology used. The prevalence of preterm births was 11.9%. This author found that preterm birth was significantly associated with the following factors: previous history of stillbirth, smoking during pregnancy, maternal weight gain less than 13 kg, arterial hypertension, vaginal bleeding, infection of the genitourinary tract and five or fewer prenatal consultations.

The study by Rondó et al¹⁶ used cohort methodology and was conducted in Jundiá (Southeastern Brazil) between September 1997 and August 2000, among women who attended prenatal care within the Brazilian national health system (*Sistema Único de Saúde, SUS*). Their study had the aims of evaluating the prevalence of stress during pregnancy and testing associations between psychological stress or distress among the mothers and low birth weight, preterm birth and IUGR. The method used was to measure stress and distress at interviews that was held at three times during the pregnancy: less than 16 weeks, 20 to 26 weeks and 30 to 36 weeks. The study followed up 865 pregnant women, with a loss rate of 27%. The prevalence of preterm births was 4.2%. Maternal distress was shown to be associated with low birth weight (RR = 1.97, $p = 0.02$) and preterm birth (RR = 2.32, $p = 0.015$).

Almeida et al¹ conducted a study in Campinas (Southeastern Brazil), with the aim of comparing the care received during gestation, delivery and the puerperium among women belonging to two per capita family income strata (less than one minimum monthly salary [MMS] and greater than or equal to one MMS). This was a cross-sectional study with a random sample of 248 women who had given birth between April 2001 and March 2002. The Kessner index was used to investigate the adequacy of the prenatal care, along with another index that the authors proposed, based on the recommendations from the Ministry of Health. Interviews were held in the women's homes. The way in which the newborns' gestational age was obtained was not reported. The prevalence of preterm birth was 11.3%, such that it was 13.1% in the stratum with income less than one MMS and 9.8% in the stratum of income greater than or equal to one MMS ($p = 0.4$). The prevalence of preterm births was not statistically different between the two groups. The authors concluded that although more women in the more prosperous group had received excellent prenatal care, the percentage of cases of inadequate prenatal care was relatively low in the poorer group.

Lunardelli & Peres¹³ conducted a population-based cross-sectional study in Itajaí (Southern Brazil), with

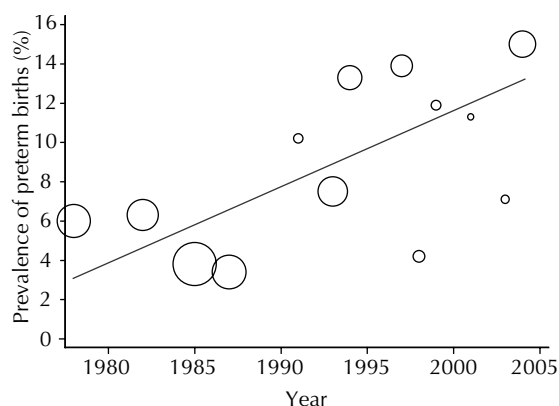


Figure. Prevalence of preterm births in Brazil, according to population-based studies, weighted by sample size.

the aim of investigating the relationship between periodontal disease in the mother and preterm birth or low birth weight. Their study consisted of interviews with the mothers and reviews of the hospital files, in 2003. They interviewed and examined a systematic sample of 449 parturients within 48 hours of the delivery. They did not report the method they used to evaluate gestational age. The prevalence of preterm births was 7.1%. No association was found between periodontal disease and low birth weight. The crude association between preterm birth and periodontal disease disappeared after adjustment for the variables of the mother's health during pregnancy.

Barros et al³ studied all of the 4,231 live births in Pelotas (Southern Brazil) in the year 2004, in a third prospective cohort study, similar to the studies conducted in 1982 and 1993. The prevalence of preterm births was 15.0%. The rate of preterm deliveries was almost twice what it had been in the 1993 study (7.5%). The rate of low birth weight remained unchanged (around 10% in both studies). The apparent incongruence between these two results could be explained by the concentration of preterm births observed in 2004 at the gestational ages of 35 and 36 weeks, when the infants already presented weights of more than 2,500 g.¹⁷

The Figure summarizes the prevalences of preterm births in Brazil. Except for the findings of Rondó et al,¹⁶ the results indicate a tendency towards increased prevalence of preterm births starting in the 1990s ($p = 0.004$). Particularly in the two cities that were studied on more than one occasion (Ribeirão Preto and Pelotas), this increase was consistent.

DISCUSSION

According to data from SINASC,^a which have been available online since 1994, the prevalence of preterm

^a Ministério da Saúde. Informações de saúde. Estatísticas Vitais - Mortalidade e Nascidos Vivos. Brasília [s.d. =?]. Available at: <http://w3.datasus.gov.br/datasus/datasus.php?area=359A1B378C5D0E0F359G22HJd5L25M0N&VInclude=../site/infsaude.php&VObj=http://tabnet.datasus.gov.br/cgi/defotm.exe?sinasc/cnv/nv>

births in Brazil was 5% in 1994, 5.4% in 1998, 5.6% in 2000 and 6.5% in 2004. However, this slight increase does not correspond to the marked increase shown in the present review. Studies carried out in the same location, like the cohorts in Ribeirão Preto and Pelotas have shown a trend of increasing prevalence of preterm birth. In Ribeirão Preto, over a 15-year period, the prevalence of preterm births increased from 6.0% (1978-79) to 13.3% (1994). In Pelotas, three cohorts of live births were recruited, one every eleven years. The prevalence of preterm births increased from 6.0% in 1982 to 7.5% in 1993 and to 15.0% in 2004. These increases in preterm births and low birth weight have had the consequence of stabilizing the infant mortality rates, since the concomitant improvement in the care provided for preterm neonates was offset by the increase in prematurity.⁴

The only study included in this review that produced results contrary to the idea that the prevalence of preterm births has been increasing was the one by Rondó et al¹⁶ (Jundiaí, from 1997 to 2000). This can be explained by the facts that that study only included SUS patients, excluded women at higher risk of premature delivery and presented a high rate of losses (27%).

The reliability of the SINASC data on preterm births has been contested. In comparing the findings from the studies included in this review with the SINASC data for the same period and locations, a large disparity in the prevalence of preterm births can be seen. While the 1994 cohort in Ribeirão Preto⁵ showed a prevalence of preterm births of 13%, the SINASC data indicated 4%. The same occurred in São Luis in 1997-98, with 14% from the study by Silva et al¹⁹ and 2% from SINASC; and with the 2004 cohort in Pelotas, with 15% from the study by Barros et al³ and 10% from SINASC. The possible causes of these differences include the quality of the information on gestational age, which was probably less standardized in the SINASC data, and the greater number of unknown values in the SINASC data than in the survey data. Nonetheless, four of the papers analyzed in this review (all from investigations in the southern and southeastern regions) did not mention the methodology used to measure the gestational age of the newborns. This indicates that there were also limitations in the studies accomplished using primary data, at least with regard to the reports produced.

The trend observed in Brazil has also been seen in other countries. In a comparison of the duration of single pregnancies in the United States between 1992 and 2002, a marked decrease in the number of deliveries at gestational ages greater than or equal to 40 weeks and an increase in the deliveries between 34 and 39 weeks was observed ($p < 0.001$), both in relation to deliveries with premature membrane and as a result of medical interventions.⁸

In Denmark, also among deliveries from single pregnancies, it was found that the proportion of preterm deliveries between 1995 and 2004 increased by 22%, or by 51% (from 3.8% to 5.7%) if only the low-risk primiparae were considered.¹²

On the other hand, a study in the Australian state of New South Wales between 1990 and 1997 did not find any changes in the rate of preterm births among low-risk.¹⁵

With regard to the risk factors for the occurrence of preterm births, the articles included in the present review indicated that these risks were low weight presented by the mother before the pregnancy, extremes of maternal age,² previous history of stillbirth, smoking during pregnancy, insufficient weight gain by the mother, arterial hypertension, vaginal bleeding, infection of the genitourinary tract, five or fewer prenatal consultations,¹⁴ maternal distress,¹⁶ low schooling level, belonging to the informal workforce and doing work that required standing up.^a The study comparing two birth cohorts in Ribeirão Preto (1978-79 and 1994)⁶ suggested that the high rates of cesarean sections and the increased numbers of mothers without a partner might be partially responsible for the increased prevalence of preterm births. However, comparison between the three birth cohorts⁴ in Pelotas (1982, 1993 and 2004) showed that there were increased numbers of preterm births both from vaginal and from cesarean deliveries. This suggests that there must have been a shared reason, such as an increased rate of terminations, either by cesarean section or by induced delivery. Other factors associated with preterm birth may include incorrect determination of gestational age based on ultrasound examinations and low quality of prenatal care, thereby failing to control infections that lead to premature rupture of the membranes.⁴

Data from the 2004 cohort in Pelotas showed that, contrary to what is seen in developed countries,⁹ children with gestational ages between 34 and 36 weeks (threshold preterm newborns) presented a risk of dying during their first year of life that was five times greater than was the risk among children born at full term, even after adjusting for maternal morbidity and sociodemographic factors.¹⁷ Although the increasing trend towards preterm birth observed in Brazil is mainly limited to this band of threshold preterm births, its consequences for infant mortality are substantial.

In conclusion, the studies reviewed indicate that there has been an increase in preterm births in Brazil. Given the important role of infant mortality in this country, it becomes important and necessary to identify the causes of this increase, by means of specific studies. Through determining these causes, interventions for diminishing the occurrence of preterm deliveries and consequently the rates of infant mortality may be planned.

^a Oliveira MT. A saúde da mulher trabalhadora: estudo da relação entre trabalho na gestação e a ocorrência de doenças, complicação do parto e recém-nascidos prematuros na cidade do Recife, PE [master's dissertation]. Salvador: Universidade Federal da Bahia; 1992.

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