

Health in Brazil 2



Maternal and child health in Brazil: progress and challenges

Cesar G Victora, Estela M L Aquino, Maria do Carmo Leal, Carlos Augusto Monteiro, Fernando C Barros, Celia L Szwarcwald

In the past three decades, Brazil has undergone rapid changes in major social determinants of health and in the organisation of health services. In this report, we examine how these changes have affected indicators of maternal health, child health, and child nutrition. We use data from vital statistics, population censuses, demographic and health surveys, and published reports. In the past three decades, infant mortality rates have reduced substantially, decreasing by 5·5% a year in the 1980s and 1990s, and by 4·4% a year since 2000 to reach 20 deaths per 1000 livebirths in 2008. Neonatal deaths account for 68% of infant deaths. Stunting prevalence among children younger than 5 years decreased from 37% in 1974–75 to 7% in 2006–07. Regional differences in stunting and child mortality also decreased. Access to most maternal-health and child-health interventions increased sharply to almost universal coverage, and regional and socioeconomic inequalities in access to such interventions were notably reduced. The median duration of breastfeeding increased from 2·5 months in the 1970s to 14 months by 2006–07. Official statistics show stable maternal mortality ratios during the past 10 years, but modelled data indicate a yearly decrease of 4%, a trend which might not have been noticeable in official reports because of improvements in death registration and the increased number of investigations into deaths of women of reproductive age. The reasons behind Brazil's progress include: socioeconomic and demographic changes (economic growth, reduction in income disparities between the poorest and wealthiest populations, urbanisation, improved education of women, and decreased fertility rates), interventions outside the health sector (a conditional cash transfer programme and improvements in water and sanitation), vertical health programmes in the 1980s (promotion of breastfeeding, oral rehydration, and immunisations), creation of a tax-funded national health service in 1988 (coverage of which expanded to reach the poorest areas of the country through the Family Health Program in the mid-1990s); and implementation of many national and state-wide programmes to improve child health and child nutrition and, to a lesser extent, to promote women's health. Nevertheless, substantial challenges remain, including overmedicalisation of childbirth (nearly 50% of babies are delivered by caesarean section), maternal deaths caused by illegal abortions, and a high frequency of preterm deliveries.

Introduction

In the past three decades, Brazil has undergone rapid changes in terms of socioeconomic development, urbanisation, medical care, and the health of the population. The first report¹ in this Series described how the country evolved in a few decades from a low-income, mostly rural country with multi-tiered health services to a middle-income, urban country with a unified health system. This report addresses how trends in maternal and child health were affected by such changes. We expand on a previous analysis of time trends in inequalities in maternal and child health in Brazil,² and discuss the health of pregnant women in the context of reproductive rights, which include the right to reproductive choice, safe motherhood, and sexuality without coercion.^{3,4} Our analyses focus on abortion, contraception, pregnancy, and delivery care (see panel 1 for data sources). Injuries (including sexual violence) and infectious and chronic diseases in women will be discussed elsewhere in this Series.^{18–20} The discussion of child health is restricted to children younger than 5 years, and focuses on infants because infant deaths account for 90% of all deaths of children younger than 5 years.²

Maternal and child health, which have improved with time, show how Brazil has evolved in terms of health systems, health conditions, and broader social

Lancet 2011; 377: 1863–76

Published Online

May 9, 2011

DOI:10.1016/S0140-6736(11)60138-4

See [Comment](#) *Lancet* 2011; 377: 1721, 1722, and 1724

See [Online/Comment](#)

DOI:10.1016/S0140-

6736(11)60326-7, and

DOI:10.1016/S0140-

6736(11)60437-6

This is the second in a [Series](#) of six papers on Health in Brazil

Post-Graduate Programme in Epidemiology, Federal University of Pelotas, Pelotas, Brazil (Prof C G Victora MD); Institute of Collective Health, Federal University of Bahia, Salvador, and Brazilian National Council for Women's Rights, Brasilia, Brazil (E M L Aquino MD); National School of Public Health (Prof M d C Leal MD) and Institute of Communication, Information Science and Technology in Health

Key messages

- The health and nutrition of Brazilian children has improved rapidly since the 1980s. A key indicator of Millennium Development Goal 1 (a reduction in the number of underweight children by half between 1990 and 2015) has already been met and Millennium Development Goal 4 (a two-thirds reduction in mortality rate of children younger than 5 years by 2015) will probably be met within the next 2 years.
- Progress in maternal mortality ratios is difficult to measure because time trends are distorted by improvements in vital statistics, but evidence exists of a decrease in maternal mortality ratios in the past three decades. However, Millennium Development Goal 5 (a reduction in maternal mortality by three-quarters between 1990 and 2015) will probably not be met.
- Regional and socioeconomic inequalities in intervention coverage, nutrition, and health outcomes in Brazil have largely decreased.
- The main factors that drive such trends probably include improvements in social determinants (ie, poverty, education of women, urbanisation, and fertility), non-health-sector interventions (ie, cash transfers, water, and sanitation), and the creation of a unified national health system with geographical targeting for primary health care (giving previously underserved populations better access to health care), in addition to disease-specific programmes.
- Major challenges exist, including a reduction of the high frequency of caesarean section, illegal abortions, and preterm births, in addition to achieving further reductions in regional and socioeconomic inequalities in health.

(Prof C L Szwarcwald), Oswaldo Cruz Foundation, Rio de Janeiro, Brazil; Faculty of Public Health, University of Sao Paulo, Sao Paulo, Brazil (Prof C A Monteiro); and Catholic University of Pelotas, Pelotas, Brazil (Prof F C Barros)

Correspondence to: Prof Cesar G Victora, Universidade Federal de Pelotas, CP 464, 96001-970 Pelotas, RS, Brazil
cvictora@gmail.com

determinants, which are discussed elsewhere in this Series.^{1,19–21} In the past 50 years, Brazil has evolved from a predominantly rural society to one in which more than 80% of the population live in urban areas, fertility rates have decreased from more than six to fewer than two children per woman, primary education became universal, and life expectancy at birth has increased by about 5 years every decade.^{1,21} The proportion of all deaths due to infectious diseases decreased substantially—Brazil is successful in the control of vaccine-preventable diseases and HIV/AIDS.¹⁸

Brazilian health policies and systems have changed much in the past three decades.¹ In the late 1980s, a three-tiered health-care system with private, social security, and charitable institutions was replaced with a universal, tax-funded, national health system. Primary health care became the cornerstone of the system, and geographical targeting of care led to the setting-up of family health teams in the neediest areas of the country. At the same time, investments were made to improve human resources for health and scientific and technological development in the health sector.^{1,21} Since the 1990s, governmental policies have become increasingly focused on the provision of social

protection mechanisms—not only the well known conditional cash transfer schemes but also the promotion of social inclusion in all sectors of society. As a result of such changes, the long-standing and pronounced differences in access to health care that exist between the wealthy south and southeast regions and the poor north and northeast regions have decreased, as has the financial gap between the wealthiest and poorest families in Brazil.^{1,21}

Reproductive and maternal health

Maternal mortality constitutes a severe violation of the reproductive rights of women²² because most maternal deaths can be prevented with early and appropriate care.²³ Until the late 1970s, maternal health issues were not on the scientific or health policy agendas in Brazil. This soon changed after 1980, when several maternal health policies and programmes were implemented. These initiatives, in addition to broader social changes such as improvements in women's education, urbanisation, and the changing role of women in society (ie, women entering the labour market and having fewer children), positively affected sexual and reproductive indicators. Although most Brazilian women described their religion as Roman Catholics, in 2006, 78.5% of married women reported use of modern contraceptive methods, compared with only 57% in 1986. The total fertility rate decreased sharply from 6.3 children per woman in the early 1960s to 1.8 children per woman in 2002–06.¹² The reduction in fertility rate has been slower for adolescents than for older mothers—39 in every 1000 women aged 10–19 years gave birth in 2006, which was a slight reduction from 45 in 1996, and for girls aged 10–14 years the birth rate increased slightly from 3 to 4 per 1000 women in the same period.²⁴ More than 20% of all infants in Brazil are born to adolescent mothers.²⁴ Access to antenatal care and delivery in a health facility also increased rapidly (as discussed later in this report). Greater use of health care, however, was accompanied by overmedicalisation (caesarean sections, episiotomies, multiple ultrasound scans, etc). Caesarean sections and routine episiotomies are common.¹²

Caesarean sections

About 3 million births occurred in Brazil in 2007—89% were delivered by physicians and 8% by nurse-midwives (mostly in the north and northeast regions).¹² Almost half (47%) of all births were by caesarean section—caesarean sections constituted 35% of deliveries in the Unified Health System (SUS; in which three-quarters of all births take place) and 80% of deliveries in the private sector. 48% of women with first-time pregnancies gave birth by caesarean section.¹² Brazilian caesarean sections rates are substantially greater than the upper WHO-recommended limit of 15%,²⁵ and higher than has been reported in any other country.²⁶ Almost half (46%) of all

Panel 1: Data sources

Our review is based on data from four sources: vital statistics, national maternal and child health surveys, population censuses, and a review of published studies. The Ministry of Health created the Mortality Information System (SIM) in 1976⁵ and the Live Births Information System (SINASC) in 1990.⁶ These web-based systems allow data to be disaggregated at the level of the 27 states and 5564 municipalities. SIM provides information on the underlying cause of death and on demographic characteristics (age, sex, etc). On the basis of comparison of indirect mortality estimates from censuses and surveys, an estimated 89% of deaths at all ages are reported to SIM; for infant deaths, coverage was 72% in 2006, up from less than 60% in the early 1990s.⁷ Burials in unofficial cemeteries, for which a death certificate is not needed, result in under-reporting of deaths—in the northeastern region, slightly more than half of infant deaths are registered.⁷ SINASC provides a broad range of information, including characteristics of mothers, pregnancies, and deliveries, and has a national coverage of 92%. In the report we used child mortality estimates that are based on a combination of vital statistics for eight states with full coverage, and indirect estimates that are based on censuses and probability surveys for the other 19 states. National mortality rates were estimated with a combination of state-level estimates, weighted by the number of livebirths.⁸ For obtaining cause-specific death rates, we applied the proportions of registered deaths by cause—after exclusion of those that were ill-defined—to the estimated infant mortality rates. Further details of the data sources, methods, and ascertainment of causes of death are available elsewhere.²⁹

Population censuses took place in 1970, 1980, 1991, and 2000,¹⁰ and annual multipurpose national household surveys often include health information.¹¹ Dedicated maternal-health and child-health surveys were done in 1986, 1996, and 2006–07,^{12–14} providing indirect child-mortality estimates and data for coverage of maternal-health and child-health interventions. The 1996 and 2006–07 surveys also assessed child nutritional status. Additional anthropometric surveys were done in 1974–75¹⁵ and 1989.¹⁶ A comprehensive review of published studies, governmental websites, and documents from our personal libraries since 1980 helped identify additional publications on maternal and child health in Brazil and on their determinants.¹⁷

caesarean sections were scheduled, according to the mothers interviewed in the 2006 demographic and health survey.²⁷

Figure 1 shows caesarean section trends in the past four decades. Although different sources of data were used—the social security system for 1970–80,²⁸ the Live Births Information System⁶ from 1995 onwards, and information from the 1981, 1986, 1996, and 2006–07 national surveys—a clear upward trend exists. In only 8 years (2001–08) the caesarean section rate increased from 38·0% to 48·4%, and in several states vaginal births are outnumbered by caesarean sections.

Births by caesarean section are more frequent among women from higher socioeconomic groups, women with more years of schooling, and white women.^{30–32} The extent to which the increase in number of caesarean sections can be attributed to mothers' demand or to medical preference is a matter of much debate. In questionnaire-based studies,^{33,34} most mothers report a preference for vaginal delivery, but in-depth interviews³⁵ suggest a widespread belief that caesarean sections are a better form of delivery than vaginal birthing because they are less painful. In two private hospitals in Rio de Janeiro, 70% of 437 women stated at the beginning of their gestation period that they would prefer a vaginal delivery—at the time of labour, however, only 30% of women maintained their original preference and only 10% of births were delivered vaginally.³³ Similar findings have been recorded in other states.³⁶ Caesarean sections are often done during daytime hours on weekdays, which suggest that they are convenient for doctors to do. (Barros AJD, unpublished).

The increasing rates of caesarean sections in the past 40 years have worried public health professionals and feminist groups alike.³⁷ In the 1970s, when the preference for caesarean sections became more common, doctors and hospitals earned more from the social security system for a caesarean section than they did for a vaginal delivery, which contributed to the increasing frequency of caesarean sections.³⁸ In reaction to this upward trend, equal pay for all types of delivery was instituted from 1980, but this led to only a temporary halting of the increase in number of babies delivered by caesarean section.³⁹ Other government policies were launched in an attempt to control the growing number of surgical deliveries; in 1998, the SUS established a limit of 40% for the proportion of institutional deliveries that they would reimburse, and this limit was gradually reduced to 30% by 2000. In 2000, an agreement between state administrations and the Ministry of Health (Pact for the Reduction of Caesarean Sections) was signed that aimed to reduce the frequency of caesarean sections to 25% of all births by 2007. These policies had a notable effect because the proportion of all caesarean sections that were reimbursed by the SUS decreased from 32·0% in 1997 to 23·9% in 2000 (figure 1). However, the Pact's effect was short lived, especially in the private sector, and the rates

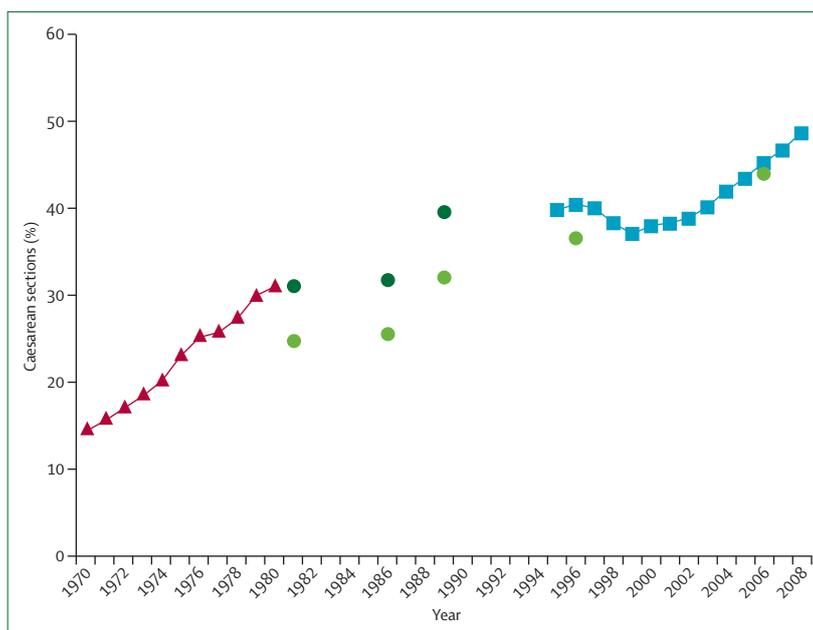


Figure 1: Caesarean sections in Brazil

Lines are data from hospital information systems (red line=social security;²⁸ blue line=live births information system⁶) and dots are data from national surveys^{27–34,36,39} (light green dots=% of all births; dark green dots=% of hospital births).

increased steadily after 2002. Women's movements have reacted strongly against overmedicalisation,³⁷ which has led to new policies such as the 2000 National Programme for the Humanization of Antenatal, Delivery and Post-Partum Care,⁴⁰ and the 2005 ruling that encourages the presence of a doula (an assistant who provides physical and emotional support) during labour in public hospitals.⁴¹ Despite evidence that caesarean sections, even if elective, are associated with increased maternal morbidity and mortality,^{42,43} there is no sign that the current upward trend is being stemmed.

Maternal mortality

Maternal mortality estimates in Brazil are affected by under-registration of deaths—especially in rural areas and small towns,⁷ where mortality ratios tend to be highest—and by under-reporting of maternal causes in registered deaths.² A reproductive-age mortality survey in all state capitals in 2002 estimated a maternal mortality ratio (MMR) of 54·3 per 100 000 population, ranging from 42 in the south region to 73 in the northeast region.⁴⁴ This survey showed that many maternal deaths had been overlooked by the vital registration system, being attributed to other causes.

As a result of a political movement to increase the awareness of maternal mortality, several initiatives have helped improve the reporting of maternal deaths, including compulsory investigations into deaths of women of reproductive age.⁴⁵ There are now maternal mortality committees in all 27 states, in 172 sub-state regions, and in 748 municipalities.⁴⁵ Such measures led

to improved detection and reporting of maternal deaths, but affects the interpretation of time trends and regional differences because the quality of reporting varies according to time and place. As of 2009, more than 40% of all deaths in women of reproductive age in the country were investigated. According to governmental statistics,⁴⁵ the maternal mortality ratio has been stable since 1996, at around 50 deaths per 100 000 livebirths. These estimates have not been corrected for changes in the proportion of deaths that are registered, nor for changes in the proportion of deaths of women of reproductive age that are investigated in detail.

Several alternative MMR estimates are available, with widely discrepant results.⁷ Two new sets of estimates were made available in 2010. Hogan and colleagues⁴⁵ predicted an MMR of 55 per 100 000 livebirths for Brazil in 2008, by use of a regression model based on total fertility rate, gross domestic product per head, HIV prevalence, neonatal mortality, and the level of a mother's education. The UN estimate a ratio of 58 maternal deaths per 100 000 livebirths for 2008,⁴⁶ with a model based on gross domestic product per capita, general fertility rate, and skilled birth attendance.⁴⁶ Annual reductions in Brazil's MMR were predicted by Hogan and colleagues (3·9% per year) and by the UN (4·0% per year), which are not surprising in view of the fact that there were favourable trends in these explanatory variables over time (as discussed later in this report).

According to the International Classification of Diseases,⁴⁷ the leading causes of registered maternal deaths in Brazil in 2007 were hypertensive disorders (23% of all maternal deaths), sepsis (10%), haemorrhage (8%), complications of abortion (8%), placental disorders (5%), other complications of labour (4%), embolism (4%), abnormal uterine contractions (4%), and HIV/AIDS-related disorders (4%). Other direct causes accounted for 14% of all deaths and other indirect causes for 17%. Abortion-related deaths are likely to be under-reported, as discussed later in this report.

Maternal deaths, however, are only part of the challenges facing the health of pregnant women. Obstetric complications are the leading causes of hospital admission for women of reproductive age, accounting for 26·7% of all admissions (total of 1060 538 admissions in 2008), second only to uncomplicated deliveries.⁴⁸ A nationwide study based on secondary data suggested that near-miss events (events in which a pregnant woman comes close to death but does not die) affect about 4% of all deliveries, especially those related to infection, pre-eclampsia, and haemorrhage.⁴⁹ This rate is about four times higher than such rates in developed countries.⁵⁰

What can be concluded about levels and trends in maternal mortality in Brazil? First, MMRs are still unacceptably high; even with under-registration, ratios are five to ten times higher than in high-income countries.^{51,52} Second, regional disparities are substantial, underlining the

socioeconomic differences and inequalities in access to health care that exist between the north and northeast regions and the south and southeast regions. Third, although the official MMR has been stable in the past 15 years, modelled estimates suggest that ratios are declining, but trend analysis is obscured because of improved surveillance. This finding would explain the apparent disconnect between time trends in the MMR and improved coverage with reproductive health indicators (table).

Illegal abortions

Induced abortions are illegal in Brazil, except for women who have been raped or when a pregnancy endangers a woman's life. Even for severe fetal malformations such as anencephaly, judicial authorisation is needed. The illegality of abortion has not stopped abortions from being done,⁵⁴ has contributed to unsafe practices, and has restricted the reliability of abortion statistics. In a 2010 national survey of urban areas, 22% of 2002 women aged 35–39 years reported having had an induced abortion.⁵⁵

Unsafe abortions are a major cause of morbidity. In 2008, 215 000 hospital admissions within the SUS were for abortion-related complications, of which only 3230 were for legal abortions. Assuming that one in every five abortions results in admission to hospital, this finding would suggest more than a million induced abortions are done in 2008 (21 per 1000 women aged 15–49 years).⁵⁶ In the same year, there were about 3 million births in the country,⁶ suggesting that one in four pregnancies was terminated.

Among all maternal causes of death, those caused by abortion-related complications are the least likely to be properly reported.⁵⁷ In the 2002 reproductive age mortality survey, 11·4% of all maternal deaths were a result of abortion-related complications.⁵⁸ Such deaths are unevenly spread in the population; reliable information on incidence is not available, but young, black, periurban, and poor women seem to be most commonly affected.^{55,59} Black women are three times more likely to die from unsafe abortions than are white women.⁵⁹ These inequalities arise from differentials in access to contraceptive methods—even though such discrepancies are decreasing over time²—and are compounded by hard-to-quantify factors such as intimate-partner violence.²⁰ National surveys in 1986, 1996, and 2006–07 recorded that about 20% of women with young children reported that their most recent pregnancy was unintended.

A variety of methods are reportedly used to induce abortions, ranging from dangerous methods used outside the health sector to safe procedures in illegal, private clinics. Misoprostol is widely available at low cost, and is often used to induce abortions in women who then go to government health facilities for curettage. In a national survey of urban areas, drugs were used to induce 48% of all reported abortions.⁵⁵

A heated political debate is underway in the Brazilian Parliament. On the one hand, there are projects aimed

	Before 1985	1986 ⁴⁴	1996 ⁵³	2006-07 ²²
Any contraceptive use in women living with their partner (%)	..	65.8%	76.7%	80.6%
Modern contraceptive use in women living with their partner (%)	..	57.0%	72.0%	78.5%
Pregnancy and delivery care (5 years before survey)				
Any antenatal care (% of all women)	74.7% (1981) ²⁹	74.0%	85.7%	98.7%
Antenatal care (>six visits; % of all women)	40.5% (1981) ²⁹	..	75.9%	80.9%
Started antenatal care during first trimester of pregnancy (% of all women)	..	..	66.0%	83.6%
Received ≥one dose of tetanus toxoid vaccine during pregnancy (% of all women)	..	..	58.5%	76.9%
Institutional delivery (%)	79.6% (1981) ²⁹	80.5%	91.5%	98.4%
Caesarean section delivery (%)	24.6% (1981) ²⁹	25.4%	36.4%	43.8%*
Vaccine coverage for children aged 12-23 months (informed plus confirmed doses)				
Measles vaccine (%)	16% (1975); ⁵³ 56% (1980) ⁵³	79.4%	87.2%	100%
Diphtheria, tetanus, and pertussis vaccine (%)	20% (1975); ⁵³ 37% (1980) ⁵³	68.9%	80.8%	98.2%
Other health-related indicators (all children younger than 5 years)				
Oral rehydration solution or recommended home fluids (%)	0% (not yet implemented)	10.9%	53.6%	52.1%
Received care for cough or fever (%)	..	..	18.2%	52.0%
Public water supply (%)	32.8% ⁸² (1975)	..	78.7%	81.8%

For the first column (Before 1985), the year in which data is from is given in parentheses. ..=data not available. *The survey-based estimate of caesarean sections is slightly lower than that reported by the Live Births Information System.

Table: Coverage of indicators for reproductive, maternal, and child health from national surveys

at expanding pro-choice rights, including the decriminalisation of abortion. On the other hand, however, some members of parliament are trying to pass laws that would make any type of abortion illegal, including those of pregnancies that are a result of rape and when fetuses have serious malformations. In the 2010 presidential campaign, the two leading candidates, including the newly elected president who pursued an otherwise progressive political agenda, expressed anti-abortion views. Nevertheless, there are early indications that a more liberal agenda will be pursued after the election, at the very least ensuring appropriate health care for women who underwent illegal abortions. Such anti-abortion views are common in countries with a Catholic majority, even though there has been substantial progress in other Latin American countries (eg, Mexico, where abortions are legal in the capital city). Epidemiological evidence on the social and health effects of illegal abortions should be used to refocus the debate on abortion, moving the discussion away from a purely moral perspective to focus on the sexual, reproductive, and health rights of women.

Child health

Unlike maternal health, the health of young children has been high on the political agenda for several decades. For example, the increase in infant mortality rates in some large cities during the 1970s—when the military regime was claiming record economic growth—was used by the democratic opposition as evidence that the so-called Brazilian economic miracle was failing to improve living conditions.⁶⁰ Greater awareness of the status of child health than of maternal health is probably because child health has historically been regarded as a general

indicator of living standards and is easier to measure than is maternal mortality.

Indirect estimates show a slight decline in infant mortality from 162 deaths per 1000 livebirths in 1930 to 115 deaths per 1000 livebirths in 1970¹⁰—about a 1% decrease every year. In the 1970s, the annual rate of reduction in infant mortalities increased to 3.2% a year, so that by 1980 the infant mortality rate was 83 deaths per 1000 livebirths. The yearly decrease accelerated after 1980s; deaths per 1000 livebirths were 47 in 1990, 27 in 2000, and 19 in 2007. The average annual rates of reduction were 5.5% a year in the 1980s and 1990s, compared with 4.4% between 2000 and 2008. Between 2000 and 2008, the yearly decrease in neonatal mortality (3.2% a year) was less than that for postneonatal mortality (8.1%); newborn deaths accounted for 68% of infant mortality in 2008. The median age of infant deaths in 1979 was 30 days, decreasing to 6 days in 2000 and to 3 days in 2007.⁶¹ Even though changes in registration and hospital deliveries can affect the median age at death, such a large decline is unlikely to be a result of reporting bias. National time-series data for birthweight-specific neonatal mortality are not available, but local-level studies have recorded pronounced improvements since the 1980s.⁶²

Mortality of children aged 1–4 years also decreased, from about six deaths per 1000 live births in 1990 to about three deaths per 1000 livebirths in 2000, and has remained stable since.² The leading causes of registered deaths in 2007 were injuries (21%), respiratory infections (15%), and other infectious diseases (such as diarrhoeal disease, sepsis, viral infections, and meningitis; 13%).⁵ Mortality rates in children aged younger than 5 years are

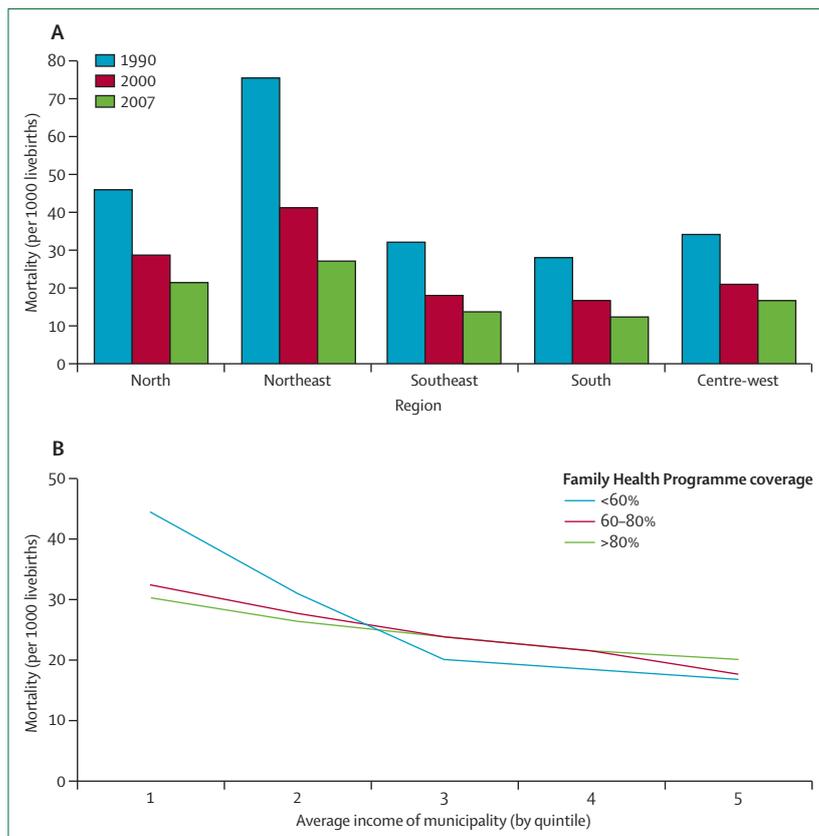


Figure 2: Infant mortality
 (A) Infant mortality by region and year.⁵ (B) Infant mortality between 2005–07 by municipality, according to average income (1=poorest; 5=wealthiest) and Family Health Programme coverage.

10% higher than infant mortality rates. As far back as data are available (the 1930s), the northeast region has had the highest rates of child mortality in the country. This region, however, has had the fastest yearly decrease in child mortality rates since 1990 (figure 2)—5.9% a year on average. In 1990, the infant mortality rate (IMR) in the northeast region was 2.6 times greater than in the south region; by 2007, its infant mortality rate was only 2.2 times greater than that of the south region—the difference in total deaths decreased even more rapidly, from 47 deaths per 1000 livebirths in 1990 to 14 deaths per 1000 livebirths in 2007. Pronounced differences in mortality rates also exist within urban areas, with higher rates in favelas, or slums, than in more wealthy neighbourhoods.⁶³

The narrowing of regional disparities was accompanied by a reduction in the difference in child mortality rates between families in the top and bottom wealth quintiles.² The difference in mortality rates between these two health quintiles decreased from 65 deaths per 1000 children in 1991 to 31 deaths per 1000 children in 2001–02. However, in 1991, the mortality rate for children younger than 5 years in the poorest quintile was 3.1 times higher than it was for children in the richest quintile, and this difference increased to 4.9 times higher in 2001–02.

These paradoxical findings—a reduction in absolute inequalities accompanied by an increase in relative inequality—are not uncommon,⁶⁴ often seen when mortality rates are falling in all socioeconomic groups, but show that there is still room for improvement among wealthier populations.⁶⁵

Ethnic group differentials in mortality are also pronounced. In 2000, mortality in children younger than 5 years was 44 deaths per 1000 black children and 29 deaths per 1000 white children.⁶⁶ In the south region of Brazil, mortality rates have decreased faster for white children than they have for black children since the 1980s.⁶⁷ In Rio de Janeiro, although all women are entitled to free delivery care in a hospital, black mothers have greater difficulty in being admitted to hospital (ie, having to visit more than one hospital before gaining access) and are less satisfied with the quality of delivery care they receive than are white mothers.⁶⁸

The largest decreases in cause-specific infant mortality in Brazil have been for deaths from diarrhoea, which decreased by 92% between 1990 and 2007, and deaths from respiratory infections, which decreased by 82% during the same period (figure 3). Also during this period, perinatal causes of death decreased by half (47%), whereas deaths due to congenital malformations remained stable. The proportion of deaths for which the cause could not be established also dropped substantially, from 9.0 deaths per 1000 children in 1990 to 0.8 deaths per 1000 children in 2007 (these deaths were proportionately allocated to the other groups of causes; figure 3).

Morbidity data show a rapid progress against some, but not all infectious diseases. Poliomyelitis was eliminated from Brazil in 1989 and the last autochthonous case of measles was in 1999.⁴¹ In the northeast region, hospital admissions for diarrhoea accounted for 57% of all admissions to hospital for children in 1980, 30% in 1990,⁶⁹ and only 7.6% in 2008–09.⁴⁸ HIV prevalence in pregnant women is estimated to be 0.4%,⁷⁰ and the vertical transmission rate in seropositive women is estimated to be 7%, ranging from 5% in the south region to 15% in the north region.⁷¹ Congenital syphilis is still a public health problem, affecting 1.7 babies in every 1000 livebirths in 2006—because of incomplete reporting, this number is probably an underestimation,⁷² and is unacceptable for a fully preventable disease,⁷³ especially in a country where antenatal care is almost universal. Trends in infectious diseases are discussed elsewhere.¹⁸ Data on stillbirths are available from vital registration.⁷⁴ In 2007, 32 165 stillbirths were reported (11 per 1000 births). The stillbirth rate has been steadily decreasing since data were first reported in 1979, when 69 159 stillborn infants were recorded (more than 20 per 1000 births). These data suggest a true decrease in the stillbirth rate, because the improvement over time in vital registration would lead to an increase, not a decrease, in these rates. In the city of Pelotas, where researchers were able to collect data for all stillbirths over

two decades, the rate of antepartum stillbirths decreased from 13·1 per thousand births in 1982 to 8·4 per thousand births in 2004, and for intrapartum stillbirths the reduction was from 2·5 to 0·7 in the same period.⁷⁵ Nevertheless, preventable stillbirths still occur. According to a study in Rio de Janeiro,⁷⁶ congenital syphilis causes 5·4% of all stillbirths. Data from a study from Belo Horizonte⁷⁷ suggest that fetal deaths due to intrapartum anoxia sometimes occur (41·4% of all fetal deaths), even in hospital settings. Of all registered stillbirths in Brazil in 2007, 29·4% occurred in children who weighed more than 2·5 kg, indicating potentially avoidable conditions.⁷⁴

Even though most indicators of health in Brazil are improving, some are getting worse. A systematic review of population-based studies on preterm deliveries showed an increase from about 4% in the early 1980s to more than 10% after 2000.⁷⁸ This upward trend was confirmed by data from repeated studies in two different cities,^{62,79} in which standardised methods were used over time. Prematurity is the most common cause of infant mortality in Brazil, and its growing frequency has largely offset the gains from improved survival of low-birthweight infants because of better newborn care.⁸⁰ The extent to which medical interventions such as caesarean sections have contributed to the increase in preterm infants is much debated in Brazil; some studies⁸¹ noted an association and others⁸² reported that preterm rates increased to a similar extent for vaginal and caesarean section births.

Most preterm infants are born at 34–36 weeks, with a birthweight of more than 2·5 kg. The prevalence of low birthweight has been stable since 2000, at around 8%.⁸³ A reduction in the frequency of intrauterine growth restriction has been reported,⁸² which could have offset the negative effect on birthweights of the increasing frequency of preterm deliveries.

Mortality rates of young Brazilian children have decreased rapidly in the past three decades, during which time regional and, to a lesser extent, social disparities have also decreased. Pronounced reductions in some causes of death—especially in those due to infectious diseases—have been accompanied by smaller reductions in neonatal mortality and by an increase in preterm deliveries.

Child nutrition

Much improvement has been made in the nutrition of Brazilian children. Data from four national surveys done during a 33-year period show a substantial decrease in the prevalence of child stunting (defined as height-for-age less than -2 Z scores of the WHO standard),⁸⁴ from 37·1% in 1974–75 to 7·1% in 2006–7. The annual rates of reduction have accelerated over time, with a 4·2% decrease between 1974–75 and 1989, a 5·4% decrease between 1989 and 1996, and a 6·0% decrease between 1996 and 2006–07.⁸⁵ Socioeconomic inequalities in stunting have also decreased. In 1974–75, children from families in the lowest wealth quintile were 4·9 times more likely to have stunted

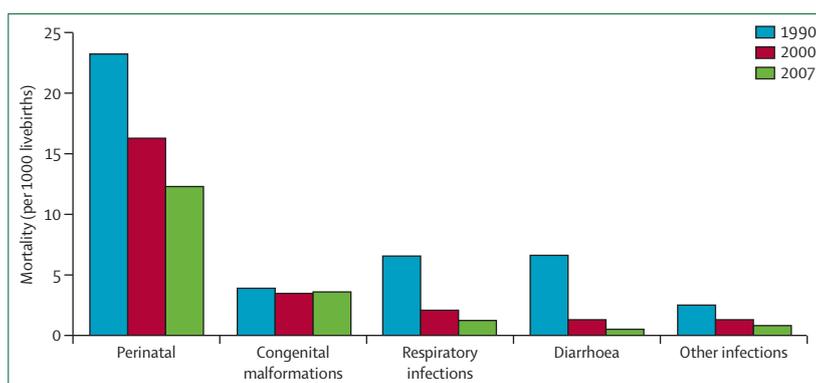


Figure 3: Infant mortality by cause and year

growth than were those from families in the highest wealth quintile—this ratio increased to 7·7 in 1989, stabilised at around 6·6 in 1996, and reduced sharply to 2·6 in 2007–08 (figure 4).

Historically, stunting prevalence is much higher in the poorest (northeast) region than in the wealthier southeast region; stunting was twice as common in the northeast region than it was in the southeast region in 1974–75, three times as common in 1989, and four times as common in 1996.⁸⁶ In the past decade, the frequency of stunting in the northeast region has reduced substantially—from 22·2% in 1996 to 5·9% in 2006–07—meaning that little difference now exists between the northeast and the wealthier regions (figure 5). The highest stunting prevalence is in the north region, which contains most of the Amazon rainforest.

Other indicators of child undernutrition have also improved. Prevalence of underweight (weight-for-age less than -2 Z scores of the WHO standard⁸⁴) decreased from 5·6% in 1989 to 2·2% in 2006–07.⁸⁵ Child obesity (weight-for-height more than 2 Z scores of the WHO standard⁸⁴) was stable at about 6–7% between 1974–75 and 2006–7,^{85,87} unlike obesity in adolescents and adults, which has increased during the same period.¹⁹

Breastfeeding practices have improved substantially. In the 1974–75 nutrition survey, the median duration of breastfeeding was only 2·5 months, one of the shortest in any developing country.¹⁵ It had increased to 5·5 months by 1989, 7 months by 1996, and 14 months by 2006–07.^{11,79,80} Exclusive breastfeeding in children younger than 4 months of age increased from 3·6% in 1986 to 48·1% by 2006–07.^{12,13,53}

No national estimates on micronutrient deficiencies exist. Data from local surveys show a high prevalence of iron deficiency, especially in children younger than 5 years,⁸⁹ despite national programmes such as flour fortification, which was instituted in 2004 and required all wheat and maize flour sold in the country to be fortified with iron and folic acid.⁹⁰ In the past, vitamin A deficiency was endemic in the rural semi-arid areas of the northeast. Up-to-date population-based information on vitamin A or

zinc deficiencies is not available, but major reductions in the prevalence of stunted growth in children, and in the number of deaths due to diarrhoea and other infectious diseases, suggest that such deficiencies do not represent a national public health problem.

Intervention coverage

Population-based data on selected maternal-health and child-health indicators are available from three demographic and health surveys done in 1986,¹⁴ 1996,¹³ and 2006–07.¹² Data for antenatal and delivery care are also available from a general household survey done in 1981.²⁹ The coverage of most indicators was, in the 1980s, high compared with present coverage in most low-income and middle-income countries.⁹¹ Nevertheless, the coverage of contraception, antenatal, and delivery care indicators increased substantially between 1986 and 2006–07. Vaccine coverage also increased rapidly and is now nearly universal. 80% of children younger than 5 years live in a home with treated water from a public source. Oral rehydration increased rapidly in the 1980s and 1990s, but has remained at about 50% coverage since, and about half of children with cough or fever are brought to a health facility—because deaths from diarrhoea and respiratory infections have become rare events, the low coverage of these two

case-management indicators does not confer a substantial health risk.

In addition to the high levels of intervention coverage, socioeconomic inequalities in coverage have decreased between 1996 and 2006–07.⁷ In 1996, 71·6% of women in the poorest family-income quintile received skilled care during childbirth compared with 98·1% of those in the wealthiest quintile; by 2006–07, the respective coverage was 96·8% and 99·5%. Contraceptive prevalence increased from 55·8% to 86·0% in the same period for individuals in the poorest quintiles, and from 76·8% to 87·3% for those in the richest quintile. The proportion of children in the poorest quintile who received care for a cough or fever increased from 33·4% in 1996 to 49·1% in 2006–07, whereas the proportion of those in the richest quintile seeking such care remained stable at 65·1% in 1996 and 63·1% in 2006–07.

Despite high coverage levels, the quality of maternal-health and child-health services is not consistently high. Data from in-depth studies show, for example, that despite an average of more than eight antenatal visits, half of the women in the city of Pelotas did not have a breast examination, and a quarter of women did not have a pelvic examination—even though 98% had one or more ultrasound scans.³⁹ Data from a national survey showed that only 62% of women giving birth in public-sector facilities had the results of a routine HIV test registered in their case notes, with pronounced variations according to education and ethnicity.⁷⁰ In a sample of women who gave birth in Rio de Janeiro, where hypertension is the leading cause of maternal deaths, only one in four had their blood pressure measured during labour.⁹³ A major paradox exists between overmedicalisation and underuse of simple but proven preventive measures such as breast and pelvic examinations, or measurement of blood pressure.

Even though coverage of antenatal and delivery care is high, such services are poorly integrated. For example, data from a survey in the Rio de Janeiro metropolitan area show that, before admission to a hospital, a third of women had to visit more than one maternity hospital during labour.⁹⁴ The most common reason they were turned away was because women with low-risk pregnancies sought care in high-complexity maternity hospitals, or because women with high-risk pregnancies sought care in low-complexity hospitals. This is a result of poor integration between antenatal services (usually provided in government health facilities) and birthing facilities, most of which are privately owned although affiliated with the SUS.⁹⁴

Understanding the changes

Time trends in maternal and child health indicators should be interpreted in view of broad social determinants of health and of governmental actions outside the health sector, and in terms of health sector interventions. Figure 6 summarises changes in these

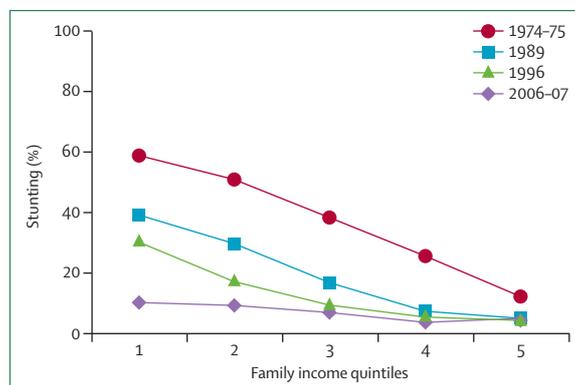


Figure 4: Prevalence of stunting by family income and year of survey
Data from reference 85.

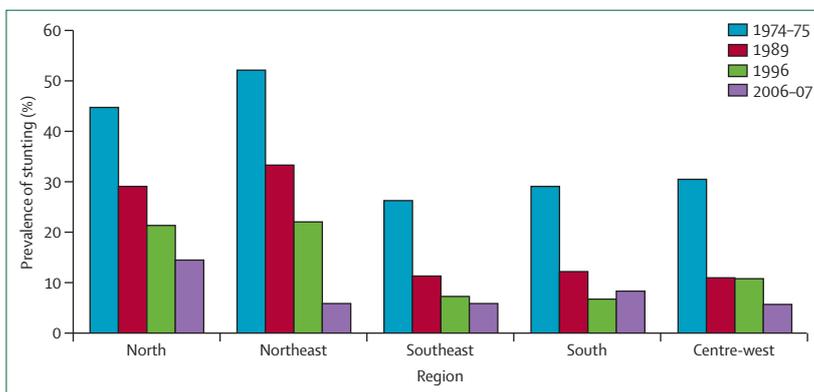


Figure 5: Prevalence of stunting by region and year
Data from reference 86.

	1970s	1980s	1990s	2000s
Political background	Military dictatorship	Transition to democracy (1985)	Early democratic period with substantial instability	Stable democracy
Economic growth	Rapid economic growth (the so-called Brazilian miracle) Increasing income concentration, accompanied by some reduction in absolute poverty	Hyperinflation and foreign debt crisis Economic stagnation and recession Increase in absolute poverty and maintenance of high income concentration	Gradual control of inflation, with slow or no economic growth Little if any changes in family income, income concentration, and poverty	Moderate economic growth with gradual reduction in income inequalities and absolute poverty achieved through a combination of unemployment reduction, progressive increase in the minimum wage, and expansion of cash transfer programmes
Demographic factors	Urbanisation and decrease in fertility rate	Urbanisation and decrease in fertility rate	Urbanisation and decrease in fertility rate	Urbanisation and decrease in fertility rate
Health systems	Three-tiered system: private; social security for regularly employed workers; and Ministry of Health and charitable services for the poorest	Three-tiered system until the creation of the Unified Health System (SUS) in 1988	Consolidation of the SUS with expansion of primary, secondary, and tertiary care Creation of the community health workers programme (1991) and family health strategy (1994) to increase access to health care in the poorest areas	Consolidation and expansion of the family health strategy
Non-health sector programmes	National food supplementation programme for mothers and children (1976) Expansion of water supply and sanitation (1975)	Continuity of food supplementation programmes Expansion of water supply and sanitation	Continuity of food supplementation programmes Expansion of water supply and sanitation Universal primary education	Creation of conditional cash transfer programmes: Bolsa Escola and Bolsa Alimentação (which replaced the food supplementation programme) and unification of programmes under Bolsa Família (2003) Expansion of water supply and sanitation Increase in secondary education
Maternal health programmes	None	National Women's Health Programme (1984)	Continued implementation of the National Women's Health Programme	National Programme for the Humanization of Pregnancy and Childbirth (2000) Pact for the Reduction of Maternal and Newborn Mortality (2004)
Child health programmes	National Immunisation Programme (1977)	Strong vertical programmes for immunisations, growth monitoring, oral rehydration, and breastfeeding promotion Mass immunisation and oral rehydration campaigns National Programme for Child Health (1984)	National Programme for the Reduction of Infant Mortality (1995)	Creation of local committees for the prevention of infant mortality (2005) Pact for Life (to reduce infant mortality; 2006)

Figure 6: Main changes in determinants of maternal and child health in Brazil

determinants since 1970, and the webappendix (p 1) shows the results of a key-informant survey of policies and programmes—including many governmental and non-governmental initiatives—that are believed to have had the largest effect on maternal and child health. From 1960 to 1980, Brazil's infant mortality rate was well above what would have been predicted on the basis of national income level (figure 7). In the 1980s, mortality rates dropped rapidly despite little change in family incomes (figure 7). Child health became more prominent on the public agenda, and strong, vertical intervention programmes were scaled up (eg, oral rehydration, breastfeeding promotion, and vaccination programmes), and were later integrated within primary health care.⁹⁷ Macro-level changes in determinants such as fertility and urbanisation probably contributed to the decrease in mortality rates (figure 6). Since the 1980s, reduction of infant mortality rates became one of the key development targets agreed on by federal, state, and municipal administrations. In several states, overall budgetary allocations to municipalities are partly related

to how rapidly infant mortality rates are reduced—other factors include demographic (eg, population size) and economic (eg, tax revenues) characteristics in each municipality.

The 1990s were characterised by the substantial expansion of primary health care, with the SUS and two related programmes: community health workers and family health. Several assessments suggest that the family health programmes contributed to mortality reduction, especially in the poorest municipalities (panel 2), even though economic growth in the 1990s was slow and the average income changed little.

After 2000, the financial gap between rich and poor populations in Brazil started to become less pronounced. There was a gradual but substantial reduction in the Gini coefficient in metropolitan areas (from 0.64 in 1991 to 0.49 in 2009),^{105,106} which can largely be attributed to cash transfer schemes and increased wages in the poorest populations. Major investments in primary schooling during the 1990s led to Brazilian mothers becoming more educated than ever before, and

See Online for webappendix

Panel 2: The Family Health Programme and infant mortality

The 1988 constitution established a universal health system that was free-of-charge for users. Because health facilities were concentrated in urban and wealthy areas, the Family Health Programme (PSF) was launched in 1994 to enable teams of doctors, nurses, and community health workers to work in the country's poorest areas. Substantial salary incentives are provided to attract workers to the programme. The programme targeted such underserved populations effectively, and uptake was notably higher in poor municipalities and in low-income neighbourhoods in urban areas, the well known favelas or urban slums that are ubiquitous in Brazilian cities.^{98,99} Municipal-level analyses suggested that the programme had a positive effect on infant mortality,^{99,100} especially through reduction of diarrhoea-related and pneumonia-related deaths,^{101,102} but no studies have been done on whether PSF helped reduce socioeconomic inequalities in infant mortality.

We used data from vital statistics to assess whether PSF implementation was associated with differentials in infant mortality (according to average municipal income) in an ecological analysis. For the 2005–07 period, 52% of Brazilian municipalities fulfilled objective criteria for reliable vital statistics, covering 72% of the national population.¹⁰³ For the other 48% of municipalities, indirect mortality estimates were used based on UN model life tables.¹⁰⁴ Census data¹⁰ were used to classify all municipalities in quintiles of average income, and information on the coverage of PSF was obtained from the Ministry of Health.

Figure 2 shows that irrespective of PSF coverage, infant mortality is higher in poor municipalities than it is in rich municipalities. However, there is an interaction between income and PSF coverage. Where PSF coverage is greater than 80%, mortality in the poorest quintile is 1.5 times greater than in the richest quintile of municipalities; this ratio is 1.8 for municipalities with coverage between 60% and 80%, and 2.6 for those with less than 60% coverage. These results should be interpreted with caution because contextual factors could affect both PSF implementation and mortality, but these findings accord with those from other evaluations that also suggest that implementation of PSF has had a positive effect on child health.

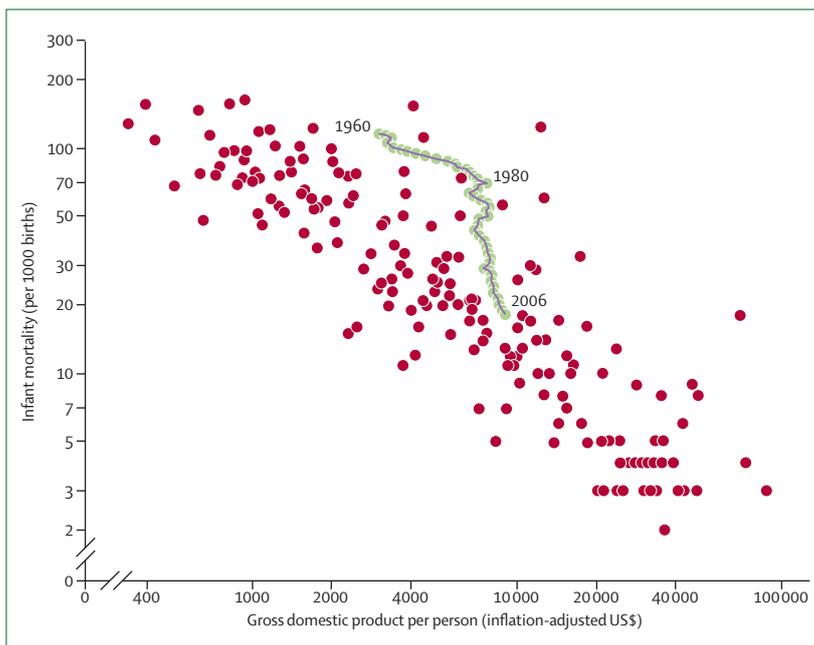


Figure 7: Income per person and infant mortality in Brazil (1960–2006) and the rest of the world (2006)
Data from reference 95 and reference 96. Each dot in the Brazilian trajectory (green circles) represents 1 year. All red dots are data from other countries in 2006. Adapted with permission from Gapminder World.

Panel 3: Important remaining challenges

- How to further reduce the regional, socioeconomic, and ethnic group disparities that persist despite overall progress?
- How to reverse the trend towards overmedicalisation of childbirth?
- How to deal with the increasing frequency of preterm births?
- How to further decrease rates of neonatal mortality, which now accounts for more than two-thirds of all infant deaths, and is decreasing more slowly than other causes?
- How to improve the quality of care, now that access to antenatal and delivery care has become almost universal?
- How to integrate antenatal and delivery care?
- How to tackle remaining problems such as unsafe abortions, avoidable maternal deaths, congenital syphilis, and adolescent pregnancies, and how to further reduce mother to child transmission of HIV?

reductions in the fertility rates meant they had fewer children to bring up. Coupled with several health-sector initiatives to reduce infant mortality (figure 6; webappendix p 3) these social and economic changes have contributed to the fact that Brazil has an infant-mortality to income-per-person ratio that is comparable with other middle-income countries (figure 7).

Among more than 50 programmes and initiatives to improve child health,¹⁰⁷ key informants (webappendix p 3) attributed the largest effect to specific programmes (for promotion of immunisation, breastfeeding, and rooming-in) and improved access to preventive and curative health care, including the SUS, the community health workers programme, and the Pastorate of the Child. The Pastorate of the Child is a Catholic-church based non-governmental organisation with 260 000 volunteers who work throughout the country to promote oral rehydration and other low-technology child survival interventions.¹⁰⁸

Child nutrition is one of the strongest proximate determinants of mortality.¹⁰⁹ A formal statistical analysis⁸⁷ of the decrease in stunting from 1996 to 2006–7 gave four major explanatory factors: increased maternal education, increased purchasing power in the poorest populations, a substantial expansion in coverage of maternal and child health services, and, to a lesser extent, the expansion of public water supply and sewage services. Changes in these distal determinants probably promoted child growth by improving diets (both breastfeeding and complementary foods), reducing infections (especially those that cause diarrhoea), and contributing to better child care.

Several explanations exist for the sharp increase in breastfeeding duration. The 1981 National Programme for the Promotion of Breastfeeding (PNIAM)^{88,110} trained health workers and interacted strongly with mass media, policy makers, and civil society organisations such as the

International Baby Food Action Network and mothers' groups. Maternity leave was extended from 2 months (as it had been since 1943) to 4 months in 1998 and to 6 months in 2006. The International Code of Marketing of Breast-milk Substitutes has been strongly enforced since 1988. Brazil also has a large network of more than 300 maternity hospitals certified by the Baby Friendly Hospital Initiative¹¹¹ and of more than 200 human milk banks.¹¹² These coordinated initiatives have meant that the median duration of breastfeeding in Brazil has increased by four times in the past three decades.^{12,13,15}

As mortality and nutrition improved, newborn health became more prominent on the national agenda. Because two-thirds of infant deaths occur in the neonatal period, and in response to the growing number of preterm births, large public investments have been made for the creation of neonatal intensive care units throughout the country. The number of beds in such units increased from 5·3 per 10 000 livebirths in 1999¹¹³ to 25·2 in 2010.¹¹⁴

In 2006–07, progress in the improvement of child mortality and nutrition meant that Brazil achieved a key indicator for the first Millennium Development Goal (MDG)—a reduction in the number of underweight children by half between 1990 and 2015.¹¹⁵ If progress continues at the present rate, the fourth MDG—a two-thirds reduction in mortality rate of children younger than 5 years by 2015—will be reached by mid-2011.² By contrast with progress in the first and fourth MDG, progress towards the fifth MDG—a reduction in maternal mortality by three-quarters relative to 1990 levels—has been slower. Since 1980, a series of national and international factors contributed to maternal health gaining prominence on the political agenda, before which time it had not featured heavily in governmental policies. In 1984, before the end of the military dictatorship and creation of the SUS,¹ pressure from feminist movements led to the establishment of the Programme of Integrated Care for Women's Health (PAISM)¹¹⁶ to ensure women's sexual and reproductive rights, more than a decade before international consensus was reached in the Cairo and Beijing conferences.¹¹⁷

Although fewer than for child health, many programmes and initiatives were launched to improve maternal health. The key informants who were surveyed for this report (webappendix p 3) mentioned, in addition to the 1984 PAISM, three broad initiatives to promote universal access to health care that had the biggest effect on maternal health—the creation of the SUS, the Community Health Worker programme, and the Family Health Programme. This finding underscores the key informants' perception of the importance of strengthening health systems for safe motherhood.²³

Some important questions remain about maternal health. Why does mortality seem to have stabilised at high levels, despite increased coverage with antenatal, delivery, and post-partum care? Even if the modelled estimates^{46,51} that predict a 4% annual decrease in MMR are correct,

present ratios of 50 per 100 000 are much larger than in high-income countries. Are there other explanations for such high MMRs—eg, poor quality of existing services? Does the likely increase in the number of maternal deaths caused by unnecessary caesarean sections⁴³ offset improvements attributable to other interventions? Rapid and sustained improvements in vital statistics in the coming years would enable inferences from maternal mortality data to be made with more confidence.

Conclusion

As a result of the changes described above, Brazil has been successful in terms of improving child health and nutrition.^{2,91} Even though questions remain about how much maternal mortality has decreased since 1990, changes in the coverage and equity of several reproductive, antenatal, and delivery care indicators are very encouraging.

Despite such progress, the mortality rate of children younger than five years is about seven times higher in Brazil than in countries with the lowest child-mortality rates,¹¹⁸ and the prevalence of stunting is about three times higher than in well-nourished populations,¹¹⁹ indicating that there is still much room for improvement (panel 3).

An overarching challenge is how to reach those who are hardest to reach, such as rural populations in the Amazon rainforest and northeast regions, including those living in the 10% of Brazilian municipalities that do not have access to a physician.²¹ The sixth article in this Series²¹ includes a call for action with specific calls to governmental, civil society, academic, and professional bodies, which must be met to overcome these challenges. The rate of reductions in stunting, infant mortality, and fertility are among the fastest ever recorded worldwide. However, as the French microbiologist Rene Dubos clearly stated more than 50 years ago, "health is a mirage that keeps receding as we think we are approaching it".¹²⁰ In Brazil, new challenges to health have appeared, and some old challenges remain unchanged.

Contributors

CGV had the idea for the report. Each co-author was responsible for drafting a section of the report. All authors revised subsequent drafts and approved its final version.

Conflicts of interest

We declare that we have no conflicts of interest.

Acknowledgments

We would like to thank James Macinko, Ricardo Uauy, Antonio Ledo Cunha, Moyses Szklo, David Sanders, Elsa Giugliani, and Alicia Matijasevich for their constructive criticism on an early draft of this report.

References

- 1 Paim J, Travassos C, Almeida C, Bahia L, Macinko J. The Brazilian health system: history, advances, and challenges. *Lancet* 2011; published online May 9. DOI:10.1016/S0140-6736(11)60054-8.
- 2 Barros FC, Matijasevich A, Requejo JH, et al. Recent trends in maternal, newborn, and child health in Brazil: progress toward millennium development goals 4 and 5. *Am J Public Health* 2010; **100**: 1877–89.
- 3 The Lancet. Women: more than mothers. *Lancet* 2007; **370**: 1283.

- 4 Glasier A, Gülmezoglu AM, Schmid GP, Moreno CG, Van Look PF. Sexual and reproductive health: a matter of life and death. *Lancet* 2006; **368**: 1595–607.
- 5 Datasus. Mortalidade geral. <http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/obt10uf.def> (accessed March 7, 2011).
- 6 Datasus. Nascidos vivos. <http://www2.datasus.gov.br/DATASUS/index.php?area=0205&VObj=http://tabnet.datasus.gov.br/cgi/deftohtm.exe:sinascp/cnv/nv> (accessed March 7, 2011).
- 7 Datasus. Razão entre óbitos informados e estimados. <http://tabnet.datasus.gov.br/cgi/ibd2007/fl11b.htm> (accessed March 7, 2011).
- 8 Rede Inter-Agencial de Informações para a Saúde (RIPSA). Indicadores Básicos para a Saúde no Brasil: Conceitos e Aplicações. Brasília: Organização Panamericana da Saúde, 2008.
- 9 Victora CG, Barros FC. Infant mortality due to perinatal causes in Brazil: trends, regional patterns and possible interventions. *Sao Paulo Med J* 2001; **119**: 33–42.
- 10 IBGE. Censos Demográficos. http://www.ibge.gov.br/home/estatistica/populacao/default_censo_2000.shtm (accessed March 7, 2011).
- 11 IBGE. Pesquisa Nacional por Amostra de Domicílios. <http://www.ibge.gov.br/home/estatistica/populacao/trabalhoerendimento/pnad2008/default.shtm> (accessed March 7, 2011).
- 12 Ministério da Saúde. PNDS 2006. Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher. Brasília; Ministério da Saúde, 2008.
- 13 Sociedade Civil de Bem-Estar Familiar/ORT Macro. Brazil DHS 1996. Final report. Rio de Janeiro: Sociedade Civil Bem-Estar Familiar no Brasil (BEMFAM), 1996.
- 14 Arruda JM, Ruttenberg N, Morris L, Ferraz EA. Pesquisa Nacional de Saúde Materno-Infantil e Planejamento Familiar (PNSMIPF) 1986. Rio de Janeiro: Sociedade Civil Bem-Estar Familiar no Brasil (BEMFAM)/Instituto para Desenvolvimento de Recursos (IRD), 1987.
- 15 IBGE/UNICEF. Perfil Estatístico de Crianças e Mães no Brasil: Aspectos Nutricionais, 1974-75. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística, 1982.
- 16 IBGE/UNICEF. Perfil Estatístico de Crianças e Mães no Brasil: Aspectos Nutricionais, 1989. Rio de Janeiro: IBGE, 1992.
- 17 WHO. Child Growth Standards based on length/height, weight and age. *Acta Paediatr Suppl* 2006; **450**: 76–85.
- 18 Barreto ML, Teixeira MG, Bastos FI, et al. Successes and failures in the control of infectious diseases in Brazil: social and environmental context, policies, interventions, and research needs. *Lancet* 2011; published online May 9. DOI:10.1016/S0140-6736(11)60202-X.
- 19 Schmidt MI, Duncan BB, e Silva GA, et al. Chronic non-communicable diseases in Brazil: burden and current challenges. *Lancet* 2011; published online May 9. DOI:10.1016/S0140-6736(11)60135-9.
- 20 Reichenheim ME, de Souza ER, Moraes CL, et al. Violence and injuries in Brazil: the effect, progress made, and challenges ahead. *Lancet* 2011; published online May 9. DOI:10.1016/S0140-6736(11)60053-6.
- 21 Victora CG, Barreto ML, do Carmo Leal M, et al. Health conditions and health-policy innovations in Brazil: the way forward. *Lancet* 2011; published online May 9. DOI:10.1016/S0140-6736(11)60055-X.
- 22 Cook RJ, Galli Bevilacqua MB. Invoking human rights to reduce maternal deaths. *Lancet* 2004; **363**: 73.
- 23 Campbell OM, Graham WJ. Strategies for reducing maternal mortality: getting on with what works. *Lancet* 2006; **368**: 1284–99.
- 24 IBGE. Estimativas Projeções População. ftp://ftp.ibge.gov.br/Estimativas_Projecoes_Populacao/Revisao_2008_Projecoes_1980_2050/Revisao_2008_Projecoes_1980_2050/ (accessed Mar 7, 2011).
- 25 WHO. Appropriate technology for birth. *Lancet* 1985; **2**: 436–37.
- 26 Betran AP, Merialdi M, Lauer JA, et al. Rates of caesarean section: analysis of global, regional and national estimates. *Paediatr Perinat Epidemiol* 2007; **21**: 98–113.
- 27 Lago TDG, Lima LP. Assistência à gestação, ao parto e ao puerpério: diferenciais regionais e desigualdades socioeconômicas. In: Ministério da Saúde/CEBRAP, ed. Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher - PNDS 2006: Dimensões do Processo Reprodutivo e da Saúde da Criança. Brasília: Ministério da Saúde/CEBRAP; 2009: 151–70.
- 28 Barros FC, Vaughan JP, Victora CG, Huttly SR. Epidemic of caesarean sections in Brazil. *Lancet* 1991; **338**: 167–69.
- 29 Travassos C, Viacava F, Laguardia J. Os Suplementos Saúde na Pesquisa Nacional por Amostra de Domicílios (PNAD) no Brasil. *Revista Brasileira de Epidemiologia* 2008; **11**: 98–112.
- 30 Gomes UA, Silva AA, Bettiol H, Barbieri MA. Risk factors for the increasing caesarean section rate in southeast Brazil: a comparison of two birth cohorts, 1978–1979 and 1994. *Int J Epidemiol* 1999; **28**: 687–94.
- 31 Leal MdC, Gama SGNd, Cunha CBD. Desigualdades raciais, sociodemográficas e na assistência ao pré-natal e ao parto, 1999–2001. *Revista de saúde pública* 2005; **39**: 100–07.
- 32 Freitas PF, Drachler Mde L, Leite JC, Grassi PR. [Social inequalities in cesarean section rates in primiparae, Southern Brazil]. *Revista de saúde pública* 2005; **39**: 761–7.
- 33 Dias MAB, Domingues RMSM, Pereira APE, et al. Trajetória das mulheres na definição pelo parto cesáreo: estudo de caso em duas unidades do sistema de saúde suplementar do estado do Rio de Janeiro. *Ciência & Saúde Coletiva* 2008; **13**: 1521–34.
- 34 Potter JE, Hopkins K, Faundes A, Perpetuo I. Women's autonomy and scheduled cesarean sections in Brazil: a cautionary tale. *Birth* 2008; **35**: 33–40.
- 35 Behague DP, Victora CG, Barros FC. Consumer demand for caesarean sections in Brazil: informed decision making, patient choice, or social inequality? A population based birth cohort study linking ethnographic and epidemiological methods. *BMJ* 2002; **324**: 942–45.
- 36 Silva AA, Lamy-Filho F, Alves MT, Coimbra LC, Bettiol H, Barbieri MA. Risk factors for low birthweight in north-east Brazil: the role of caesarean section. *Paediatr Perinat Epidemiol* 2001; **15**: 257–64.
- 37 Diniz SG, Chacham AS. "The cut above" and "the cut below": the abuse of caesareans and episiotomy in Sao Paulo, Brazil. *Reprod Health Matters* 2004; **12**: 100–10.
- 38 Gentile de Mello C. A epidemiologia da cesariana. *Rev Bras Hospitais* 1971; **3**: 29–33.
- 39 Rattner D. [On the hypothesis of cesarean birth rate stabilization in southeastern, Brazil]. *Revista de saúde pública* 1996; **30**: 19–33.
- 40 Serruya SJ, Cecatti JG, Lago TG. [The Brazilian Ministry of Health's programme for humanisation of prenatal and childbirth care: preliminary results] *Cad saude publica* 2004; **20**: 1281–89.
- 41 Ministério da Saúde. Saúde Brasil 2008: 20 anos de Sistema Único de Saúde (SUS) no Brasil. Brasília: Ministério da Saúde; 2009.
- 42 Hall MH, Bewley S. Maternal mortality and mode of delivery. *Lancet* 1999; **354**: 776.
- 43 Villar J, Valladares E, Wojdyla D, et al. Caesarean delivery rates and pregnancy outcomes: the 2005 WHO global survey on maternal and perinatal health in Latin America. *Lancet* 2006; **367**: 1819–29.
- 44 Laurenti R, Jorge MHPdM, Gotlieb SLD. A mortalidade materna nas capitais brasileiras: algumas características e estimativa de um fator de ajuste. *Revista Brasileira de Epidemiologia* 2004; **7**: 449–60.
- 45 Ministério da Saúde. Manual dos comitês de mortalidade materna. Brasília: Ministério da Saúde, 2009.
- 46 Trends in maternal mortality: 1990 to 2008. Estimates developed by WHO, UNICEF, UNFPA and The World Bank. Geneva: World Health Organization, 2010.
- 47 Datasus. Óbitos maternos. <http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/pmat10uf.def> (accessed March 7, 2011).
- 48 Datasus. Morbidade hospitalar. <http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sih/cnv/nruf.def> (accessed March 7, 2011).
- 49 Sousa MH, Cecatti JG, Hardy EE, Serruya SJ. Severe maternal morbidity (near miss) as a sentinel event of maternal death. An attempt to use routine data for surveillance. *Reprod Health* 2008; **5**: 6.
- 50 Say L, Pattinson RC, Gulmezoglu AM. WHO systematic review of maternal morbidity and mortality: the prevalence of severe acute maternal morbidity (near miss). *Reprod Health* 2004; **1**: 3.
- 51 Hogan MC, Foreman KJ, Naghavi M, et al. Maternal mortality for 181 countries, 1980–2008: a systematic analysis of progress towards Millennium Development Goal 5. *Lancet* 2010; **375**: 1609–23.
- 52 Hill K, Thomas K, Abouzahr C, et al. Estimates of maternal mortality worldwide between 1990 and 2005: an assessment of available data. *Lancet* 2007; **370**: 1311–19.

- 53 Monteiro CA. A evolução da nutrição infantil nos anos 90. In: Monteiro CA, ed. *Velhos e novos males da saúde no Brasil: a evolução do país e de suas doenças*. 2nd ed. São Paulo: Editora Hucitec/Nupens-USP, 2000: 375–92.
- 54 Singh S. Hospital admissions resulting from unsafe abortion: estimates from 13 developing countries. *Lancet* 2006; **368**: 1887–92.
- 55 Diniz D, Medeiros M. [Abortion in Brazil: a household survey using the ballot box technique]. *Cien Saude Colet*; **15** (suppl 1): 959–66.
- 56 Monteiro MFG, Adesse L. Estimativas de aborto induzido no Brasil e grandes regiões (1992–2005). Encontro Nacional de Estudos Populacionais; Caxambu, Brazil; 2006.
- 57 Menezes G, Aquino EM. [Research on abortion in Brazil: gaps and challenges for the public health field]. *Cad saude publica* 2009; **25** (suppl 2): S193–204.
- 58 Laurenti R, Mello Jorge M, Gotlieb S. A mortalidade materna nas capitais brasileiras: algumas características e estimativa de um fator de ajuste. *Rev Bras Epidemiol* 2004; **7**: 449–60.
- 59 Martins IR, Costa SH, Freitas SR, Pinto CS. [Induced abortion among low income women: dimensions of the problem]. *Cad saude publica* 1991; **7**: 251–66.
- 60 Leser W. O crescimento da população na cidade de São Paulo entre 1950 e 1970, e seu reflexo nas condições de saúde pública. *Ciência e cultura* 1975; **27**: 224–56.
- 61 Datasus. Óbitos infantis. <http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/inf10uf.def> (accessed March 7, 2011).
- 62 Barros FC, Victora CG, Barros AJ, et al. The challenge of reducing neonatal mortality in middle-income countries: findings from three Brazilian birth cohorts in 1982, 1993, and 2004. *Lancet* 2005; **365**: 847–54.
- 63 Szwarcwald CL, Andrade CL, Bastos FI. Income inequality, residential poverty clustering and infant mortality: a study in Rio de Janeiro, Brazil. *Soc Sci Med* 2002; **55**: 2083–92.
- 64 Harper S, King NB, Meersman SC, Reichman ME, Breen N, Lynch J. Implicit value judgments in the measurement of health inequalities. *Milbank Q* 2010; **88**: 4–29.
- 65 Victora CG, Vaughan JP, Barros FC, Silva AC, Tomasi E. Explaining trends in inequities: evidence from Brazilian child health studies. *Lancet* 2000; **356**: 1093–98.
- 66 UNIFEM/UNICEF. Desigualdades Raciais e de Gênero entre Crianças, Adolescentes e Mulheres no Brasil, no contexto dos Objetivos de Desenvolvimento do Milênio. Brasília: UNIFEM/UNICEF, 2010.
- 67 Matijasevich A, Victora CG, Barros AJ, et al. Widening ethnic disparities in infant mortality in southern Brazil: comparison of 3 birth cohorts. *Am J Public Health* 2008; **98**: 692–68.
- 68 Leal Mdo C, da Gama SG, da Cunha CB. [Racial, sociodemographic, and prenatal and childbirth care inequalities in Brazil, 1999–2001]. *Rev Saude Publica* 2005; **39**: 100–07.
- 69 Victora CG, Olinto MTA, Barros FC, Nobre LC. Falling diarrhoea mortality in Northeastern Brazil: did ORT play a role? *Health policy plan* 1996; **11**: 132–41.
- 70 Szwarcwald CL, Barbosa Junior A, Souza-Junior PR, et al. HIV testing during pregnancy: use of secondary data to estimate 2006 test coverage and prevalence in Brazil. *Braz J Infect Dis* 2008; **12**: 167–72.
- 71 Menezes Succi RC. Mother-to-child transmission of HIV in Brazil during the years 2000 and 2001: results of a multi-centric study. *Cad saude publica* 2007; **23** (suppl 3): S379–89.
- 72 Ramos Jr AN, Matida LH, Saraceni V, Veras MADSM, Pontes RJS. Control of mother-to-child transmission of infectious diseases in Brazil: progress in HIV/AIDS and failure in congenital syphilis. *Cadernos de Saúde Pública* 2007; **23**: S370–S8.
- 73 Walker GJ, Walker DG. Congenital syphilis: a continuing but neglected problem. *Semin Fetal Neonatal Med* 2007; **12**: 198–206.
- 74 Datasus. Óbitos fetais. <http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/fet10uf.def> (accessed March 7, 2011).
- 75 Matijasevich A, Santos IS, Barros AJ, et al. Perinatal mortality in three population-based cohorts from southern Brazil: trends and differences. *Cad saude publica* 2008; **24** (suppl 3): S399–408.
- 76 Saraceni V, Guimarães MHFds, Theme Filha MM, do Carmo Leal M. Mortalidade perinatal por sífilis congênita: indicador da qualidade da atenção à mulher e à criança. *Cad saude publica* 2005; **21**: 1244–50.
- 77 Lansky S, Franca E, Leal Mdo C. [Avoidable perinatal deaths in Belo Horizonte, Minas Gerais, Brazil, 1999]. *Cad saude publica* 2002; **8**: 1389–400.
- 78 Silveira MF, Santos IS, Barros AJ, Matijasevich A, Barros FC, Victora CG. Increase in preterm births in Brazil: review of population-based studies. *Revista de saude publica* 2008; **42**: 957–64.
- 79 Bettiol H, Rona RJ, Chinn S, Goldani M, Barbieri MA. Factors associated with preterm births in southeast Brazil: a comparison of two birth cohorts born 15 years apart. *Paediatr Perinat Epidemiol* 2000; **14**: 30–38.
- 80 Goldani MZ, Barbieri MA, Rona RJ, Da Silva AA, Bettiol H. Increasing pre-term and low-birth-weight rates over time and their impact on infant mortality in south-east Brazil. *J Biosoc Sci* 2004; **36**: 177–88.
- 81 Silva AA, Barbieri MA, Bettiol H, Goldani MZ, Rona RJ. Can we explain why Brazilian babies are becoming lighter? *Int J Epidemiol* 2004; **33**: 821–28.
- 82 Barros FC, Victora CG, Matijasevich A, et al. Preterm births, low birth weight, and intrauterine growth restriction in three birth cohorts in Southern Brazil: 1982, 1993 and 2004. *Cad saude publica* 2008; **24** (suppl 3): S390–98.
- 83 Datasus. Pacto de atenção básica 2006. <http://tabnet.datasus.gov.br/cgi/tabcgi.exe?siab/pacto2006/pacbr.def> (accessed March 7, 2011).
- 84 WHO. WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. Geneva: World Health Organization, 2006.
- 85 Monteiro CA, Benicio MH, Conde WL, et al. Narrowing socioeconomic inequality in child stunting: the Brazilian experience, 1974–2007. *Bull World Health Organ* 2009; **88**: 305–11.
- 86 Monteiro CA, Conde WL, Popkin BM. Is obesity replacing or adding to undernutrition? Evidence from different social classes in Brazil. *Public Health Nutr* 2002; **5**: 105–12.
- 87 Monteiro CA, Benicio MH, Konno SC, Silva AC, Lima AL, Conde WL. Causes for the decline in child under-nutrition in Brazil, 1996–2007. *Revista de saude publica* 2009; **43**: 35–43.
- 88 Venancio SI, Monteiro CA. A tendência da prática da amamentação no Brasil nas décadas de 70 e 80. *Rev Bras Epidemiol* 1998; **1**: 40–49.
- 89 Batista Filho M, Rissin A. A transição nutricional no Brasil: tendências regionais e temporais. *Cadernos de Saúde Pública* 2003; **19**: S181–S91.
- 90 Assunção MC, Santos IS, Barros AJ, Gigante DP, Victora CG. Efeito da fortificação de farinhas com ferro sobre anemia em pré-escolares. *Cad Saude Publ* 2007; **41**: 539–48.
- 91 Bhutta ZA, Chopra M, Axelson H, et al. Countdown to 2015 decade report (2000–10): taking stock of maternal, newborn, and child survival. *Lancet*; **375**: 2032–44.
- 92 Victora CG, Matijasevich A, Silveira M, Santos I, Barros AJ, Barros FC. Socio-economic and ethnic group inequities in antenatal care quality in the public and private sector in Brazil. *Health policy plan* 2010; **25**: 253–61.
- 93 Oliveira MI, Dias MA, Cunha CB, Leal Mdo C. [Quality assessment of labor care provided in the Unified Health System in Rio de Janeiro, Southeastern Brazil, 1999–2001]. *Revista de saude publica* 2008; **42**: 895–902.
- 94 Leal Mdo C, Gama SG, Campos MR, et al. [Factors associated with perinatal morbidity and mortality in a sample of public and private maternity centers in the City of Rio de Janeiro, 1999–2001]. *Cad saude publica* 2004; **20** (suppl 1): S20–33.
- 95 Gapminder World. <http://www.gapminder.org/world> (accessed March 7, 2011).
- 96 Gapminder Data. <http://www.gapminder.org/data> (accessed March 7, 2011).
- 97 Victora CG. Diarrhea mortality: what can the world learn from Brazil? *J Pediatr (Rio J)* 2009; **85**: 3–5.
- 98 Barros AJD, Victora CG, Cesar JA, Neumann NA, Bertoldi AD. Brazil: are health and nutrition programs reaching the neediest? In: Gwatkin DR, Wagstaff A, Yazbeck AS, eds. *Reaching the poor: with health, nutrition, and population services: what works, what doesn't, and why*. Washington: The World Bank; 2005: 281–306.

- 99 Aquino R, de Oliveira NF, Barreto ML. Impact of the family health program on infant mortality in Brazilian municipalities. *Am J Public Health* 2009; **99**: 87–93.
- 100 Macinko J, Souza MFM, Guanais FC, Simoes CCS. Going to scale with community-based primary care: An analysis of the family health program and infant mortality in Brazil, 1999–2004. *Soc Sci Med* 2007; **65**: 2070–80.
- 101 Macinko J, Guanais FC, Souza MFM. Evaluation of the impact of the Family Health Program on infant mortality in Brazil, 1990–2002. *J Epidemiol Community Health* 2006; **60**: 13–9.
- 102 Rasella D, Aquino R, Barreto ML. Reducing childhood mortality from diarrhea and lower respiratory tract infections in Brazil. *Pediatrics* 2010; **126**: 534–40.
- 103 Szwarcwald CL. Strategies for improving the monitoring of vital events in Brazil. *Int J Epidemiol* 2008; **37**: 738–44.
- 104 United Nations Population Division. Model life tables for developing countries. New York; UNPD, 1982.
- 105 Comissão Nacional sobre Determinantes Sociais da Saúde. As Causas Sociais das Iniquidades em Saúde no Brasil: Relatório Final. Rio de Janeiro: FIOCRUZ, 2008.
- 106 Instituto de Pesquisa Econômica. Desigualdade e pobreza no Brasil metropolitano durante a crise internacional: primeiros resultados. Brasília: IPEA, 2009.
- 107 Frias PG, Mullachery PH, Giugliani ERJ. Políticas de saúde direcionadas às crianças brasileiras: breve histórico com enfoque na oferta de serviços de saúde. In: Ministério da Saúde, ed. Saúde Brasil 2008: 20 anos do Sistema Único de Saúde no Brasil. Brasília: Ministério da Saúde; 2009: 85–110.
- 108 Pastoral da Criança. <http://www.pastoraldacrianca.org.br> (accessed March 7, 2011).
- 109 Black RE, Allen LH, Bhutta ZA, et al. Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet* 2008; **371**: 243–60.
- 110 Rea MF. [A review of breastfeeding in Brazil and how the country has reached ten months' breastfeeding duration]. *Cad saude publica* 2003; **19** (suppl 1): S37–45.
- 111 Unicef Brasil. Iniciativa Hospital Amigo da Criança. http://www.unicef.org/brazil/pt/hospitais_ihac_junho09.pdf (accessed March 7, 2011).
- 112 FIOCRUZ. Rede Brasileira de Bancos de Leite Humano. http://www.redeblh.iciet.fiocruz.br/producao/portal_blh/blh_brasil.php (accessed March 7, 2011).
- 113 Leal MC, Viacava F. Maternidades do Brasil. *Radis Comunicação em Saúde* 2002; **2**: 8–26.
- 114 Datasus. Rede assistencial. <http://www2.datasus.gov.br/DATASUS/index.php?area=0204&id=11658&VObj=http://tabnet.datasus.gov.br/cgi/defthtm.exe?cnes/cnv/atint> (accessed March 7, 2011).
- 115 United Nations U. The Millennium Development Goals. <http://www.un.org/millenniumgoals> (accessed March 7, 2011).
- 116 Costa AM. [Social participation in the achievement of health policies to women in Brazil]. *Cien Saude Colet* 2009; **14**: 1073–83.
- 117 Fathalla MF, Sinding SW, Rosenfield A, Fathalla MM. Sexual and reproductive health for all: a call for action. *Lancet* 2006; **368**: 2095–100.
- 118 UNICEF. State of the World's Children 2009: Maternal and Newborn Health. New York: UNICEF, 2009.
- 119 World Health Organization Expert Committee on Nutrition. Physical status: uses and interpretation of anthropometry. Geneva: WHO, 1995.
- 120 Dubos R. The mirage of health: utopias, progress and biological change. New York: Harper & Brothers, 1959.