NOTES FROM THE FIELD

Reducing Child Mortality: The Contribution of Ceará State, Northeast of Brazil, on Achieving the Millennium Development Goal 4 in Brazil

Anamaria Cavalcante e Silva · Luciano Lima Correia · Jocileide Sales Campos · Francisca Maria de Oliveira Andrade · Dirlene Mafalda Ildefonso da Silveira · Álvaro Jorge Madeiro Leite · Hermano A. L. Rocha · Márcia Maria Tavares Machado · Antonio Jose Ledo Alves da Cunha

Abstract To describe the experience of Ceará, Northeast of Brazil, state on improving child survival, over a 20 year period, and discuss its contribution to Brazil's progress toward the achievement of MDG 4. Five population-based, statewide household surveys, with children <3 years of age, known as PESMIC (Mother and Child Health Survey of Ceará), were conducted in 1987, 1990, 1994, 2001 and 2007. They aimed to investigate levels and causes of mortality and access to child health services. The cluster sampling of 8,000 households identified 2,000 children on average. They used the same methodological approach and indicators. Important changes occurred in demographic and health indicators in the 20 year period, including 81 % reduction in the infant mortality rate, 43 % increase in breastfeeding rate and the achievement of a 95 % immunization rate. The prevalence of chronic malnutrition declined from 28 to 13 % and acute malnutrition from 13 to 5 %. Diarrheal diseases contributed with 36.6 % to the infant mortality in 1986 and 3.9 % in 2007. The major improvements in child health contributed substantially to the progress on MDG 4 in Brazil. Results of the 5 surveys produced reliable information for planning and evaluation that contributed to the remarkable progress made by the state.

Keywords Health policy · Child health · Millennium Development Goals · Mortality

A. C. e Silva · J. S. Campos · D. M. I. da Silveira
Centro Universitário Christus – Unichristus, Rua Rua João Adolfo Gurgel, 133, Fortaleza, CE, Brazil
e-mail: anamariacasil@yahoo.com.br

J. S. Campos
e-mail: jocileide23@gmail.com

D. M. I. da Silveira
e-mail: dmmsilveira@hotmail.com

L. L. Correia · Á. J. Madeiro Leite · H. A. L. Rocha (✉)
Departamento de Saúde Comunitária, Universidade Federal do Ceará, Rua Prof. Costa Mendes, 1609, Fortaleza, CE 60430-130, Brazil
e-mail: hermano@ufc.br; hermanoalexandre@gmail.com

L. L. Correia
e-mail: correialuciano@hotmail.com

F. M. de Oliveira Andrade
Professora licenciada da Faculdade de Medicina do Juazeiro do Norte – Estácio, Especialista em programas, Fundo das Nações Unidas para a Infância – UNICEF, Fortaleza, Brazil
e-mail: fmandrade@unicef.org

M. M. T. Machado
Adjunta III do Departamento de Saú-de Comunitária, Harvard School of Public Health, Universidade Federal do Ceará, Rua Prof. Costa Mendes, 1609, Fortaleza, CE 60430-130, Brazil
e-mail: marciamachadoufc@gmail.com

A. J. L. A. da Cunha
Departamento de Pediatria, Universidade Federal do Rio de Janeiro (UFRJ), Av Pedro Calmon, 550, Cidade Universitaria, Rio de Janeiro, RJ 21941-901, Brazil
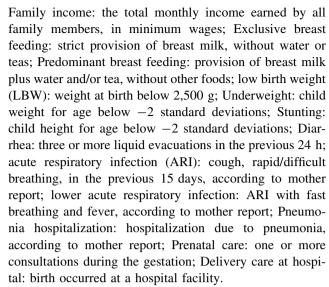e-mail: antonioledo@yahoo.com.br

Introduction

The 2000 Millennium Declaration is aimed at greatly reducing poverty, hunger, disease, maternal and child deaths and other illnesses by 2015. It is known that the world possesses the knowledge and the resources to achieve the MDGs and a number of countries have succeeded achieving them but progress has been uneven [1, 2]. Brazil is in progress to achieve the MDG 4—Reduce child mortality [3]. Part of this progress can be attributed to actions taken in the state of Ceará, located in the poorest area of Brazil, towards the improvement of child health in the last 20 years [4–6]. Other studies pointed the impact of federal programs in maternal and child health [7]. These achievements are registered in a series of five statewide population-based surveys, that produced high-quality data on forty thousand families. This paper presents and discusses the state of Ceará experience based on the results of the five studies, in a historical perspective.

Materials and Methods

The Population-based Surveys

Five population-based, statewide household surveys, known as PESMIC (Mother and Child Health Survey of Ceará), investigated children <3 years of age and their mothers, and were conducted in 1987, 1990, 1994, 2001 and 2007. The included research questions on levels and causes of mortality, malnutrition prevalence, duration of breastfeeding, immunization coverage, diarrhea management, access to health services, including antenatal care. The study sample of households in 1986 was 8,000, one of the largest done so far in the country [8], required to detect deaths of children <1 year, a rare event, even in a high mortality situation of that time [9, 10]. The selection of households followed a multi-stage cluster sampling [9, 11, 12]: (a) selection of 31 municipalities out of 184 with probability proportionate to size, (b) random selection by municipality of 400 official census tracts (standard clusters of 300 households), (c) random selection of 20 households in each tract. The 8,000 households were visited, both in urban and rural areas, by a team of trained field workers. In the surveys that followed in 1990, 1994, 2001 and 2007, the same methodological approach was used, including sample size and selection. However, in each survey new indicators for children and mothers were added to the original questionnaire. Indicators were analyzed for the whole state and stratified by geographic regions, socio-economic status and other parameters. Definitions of the main study variables were: Maternal literacy: ability to read and understand a simple health education message;

Family income: the total monthly income earned by all family members, in minimum wages; Exclusive breast feeding: strict provision of breast milk, without water or teas; Predominant breast feeding: provision of breast milk plus water and/or tea, without other foods; low birth weight (LBW): weight at birth below 2,500 g; Underweight: child weight for age below -2 standard deviations; Stunting: child height for age below -2 standard deviations; Diarrhea: three or more liquid evacuations in the previous 24 h; acute respiratory infection (ARI): cough, rapid/difficult breathing, in the previous 15 days, according to mother report; lower acute respiratory infection: ARI with fast breathing and fever, according to mother report; Pneumonia hospitalization: hospitalization due to pneumonia, according to mother report; Prenatal care: one or more consultations during the gestation; Delivery care at hospital: birth occurred at a hospital facility.

All surveys were approved by the Brazilian Ministry of Health, the Ceará State Secretariat of Health and the Federal University of Ceará. PESMICs were applied terms of informed consent, submitted to women, and children, through their mothers. Adolescents bellow 18 years old had obtained consent to participate from parents or guardians. From the fourth survey, with the introduction of the Research Ethics Committees, the protocols of the studies were approved by them.

Results

The Mortality and Main Indicators Results

Table 6 shows the official rates of reduction in infant mortality for Brazil and for Ceará State. Ceará did better than Brazil and any of the 27 states, with a 73 % reduction from 1980 to 2007 [9]. MDG 4 will be reached if progress continues at this rate, before 2015. The main causes of infant mortality in Ceará state, infectious diseases

Table 1 Proportional infant mortality by causes

Causes	Years				
	1986	1991	1995	2001	2007
Diarrheal diseases	36.6	27.5	20.3	10.0	3.9
Pneumonia	12.0	8.0	8.7	4.3	4.0
Other infectious diseases	11.6	11.1	11.7	7.8	6.7
Perinatal and congenital	35.1	45.6	52.6	67.6	76.1
Other non-infectious causes	4.7	7.9	6.7	10.3	9.2

Ceará, Brazil, 1986–2007 (*Source*: Datasus/Ministry of Health, Brazil)

Percents based on registered infant deaths of known cause

Table 2 Prevalence of diarrhea and ARI, and related health care provided to infants and under 3 years old children

Indicators	Years					% change[a]	p value[b]
	1987	1990	1994	2001	2007		
Diarrhea							
Prevalence of diarrhea in previous 15 days	30	25.1	24.5	23.6	21	−30	<0.001
Use of oral rehydration solution during diarrhea	29.8	36.2	55	56	40.2	+34.9	<0.001
Diarrhea admissions in previous 12 months	4.6	3.3	4.4	3	1.1	−76.1	<0.001
Acute respiratory infections							
Prevalence of lower ARI in previous 15 days (<1 year)	7.9	4.8	3.9	2.4	1.8	−77.2	<0.001
Children with lower ARI without a medical consultation (<1 year)	46.3	20.5	16.7	14.3	22.2	−52.1	<0.001
Pneumonia admissions in previous 12 months (<3 year)	3	1.5	2	1.2	1.1	−63.3	<0.001

Ceará, Brazil, 1987–2007 (*Source*: PESMIC surveys)

[a] Difference between last and first measurement

[b] Chi square for trend

Table 3 Prevalence of low birth weight, malnutrition and breastfeeding among under 3 years old children

Indicators	Years					% change[a]	p value[b]
	1987	1990	1994	2001	2007		
Nutritional status							
Low birth weight	10.1	10.4	6.9	6.1	7.3	−27.7	<0.001
Weight for age <−2 SD	12.5	9.6	9.1	5.3	4.7	−62.4	<0.001
Height for age <−2 SD	26.3	20.7	17.7	13.6	12.3	−53.2	<0.001
Breastfeeding							
Exclusive breastfeeding (0–4 months)	0	2.3	16	29	34	+1.378	<0.001
Predominant breastfeeding (0–4 months)	13	15	36	44	53	+307	<0.001
Still breastfed at 12–15 months	24	20.2	38.8	38.4	47.9	+99.6	<0.001
Median duration in months of breastfeeding	2	5	4	4	5	+150	0.001

Ceará, Brazil, 1987–2007 (*Source*: PESMIC surveys)

[a] Difference between last and first measurement

[b] Chi square for trend

Table 4 Proportion of children fully immunized and supplemented with vitamin A capsules

Indicators	Years					% change[a]	p value[b]
	1987	1990	1994	2001	2007		
BCG (1 or + doses)	58	82	97	95.2	94.4	+62.8	<0.001
DPT (3 or + doses)	40.2	64.2	89.9	93.7	86[c]	+113.9	<0.001
Measles (1 or + doses)	65	77	94.6	95.2	100	+53.8	<0.001
Vitamin A	9.6	…	62.1	52.6	63.5	+661.45	<0.001

Children 12–23 months old for vaccines and under 3 years old for vitamin A

Ceará, Brazil, 1987–2007 (*Source*: PESMIC surveys)

'…' Data not collected in this year

[a] Difference between last and first measurement

[b] Chi square for trend

[c] By 2007 the vaccine DPT had been replaced by the bacterial tetravalent vaccine

Table 5 Selected social-economic and reproductive indicators among families of under 3 years old children

Indicators	Years					% change[a]	p value[b]
	1987	1990	1994	2001	2007		
Family income <1 minimum wage	52.5	46.5	47.3	49.4	58.1	+10.7	<0.001
Tap water available in the household	25.3	…	25.8	67.8	59.8	+136.4	<0.001
Maternal literacy	58.4	75.1	93	92.7	96.4	+65.1	<0.001
Number of <3 year olds per woman (mean)	…	0.55	0.56	0.32	0.25	−45.4	<0.001
Attendance to antenatal care (one or more consultations)	65.0	65.5	83.1	98.2	99.0	+52.3	<0.001
Delivery care at hospital	69.2	78.5	89.3	98.1	98.3	+42.1	<0.001

Ceará, Brazil, 1987–2007 (*Source*: PESMIC surveys)

'…' Data not collected in this year

[a] Difference between last and first measurement

[b] Chi square for trend

Table 6 Infant mortality rates

	1980	1991	2000	2007	% Reduction[a]
Ceará	111.5	71.1	38.1	29.7	−73.3
Brazil	69.1	45.2	30.4	23.5	−66.7

Ceará state and Brazil, 1980–2007 (*Source*: National Institute of Geography and Statistics-IBGE, Brazil)

[a] Difference between last and first measurement, as a percentage of the first

including diarrhea and respiratory infections, decreased markedly (Table 1).

In 20 years, the prevalence of diarrhea decreased from 30.0 to 21.0 %; the use of ORS increased from 30 to 56 % in 2001, when it reached its peak level. Hospital admissions for children <1 year with diarrhea declined from 4.6 to 1.1 %, despite the increasing availability of hospital beds in the period. The prevalence ARI declined from 7.9 to 1.8 %, a 77 % reduction. The percentage of children with lower ARI who were not taken to a skilled provider, fell from 46.3 to 22.2 %. The percentage of admissions for pneumonia in the previous 12 months fell from 3 to 1.1 %, a 63 % reduction (Table 2).

In the study period, the percentage of children born with LBW fell from 10.1 to 6.1 % in 2001 [10]. In 2007 there was an increase (7.3 %), possibly due to a higher survival rate of preterm babies [13]. The prevalence of underweight declined from 12.8 to 4.7 %, a 62 % reduction. Stunting reduced from 26.3 to 12.3 %. All breastfeeding indicators improved (Table 3).

Considering 12–23 months children, who should have received all doses BCG, DPT and measles vaccines, the percentage of immunization exceeded 95 % in 2001. The percentage supplemented with vitamin A also increased in the period (Table 4). Poverty, measured by the percentage of families living with less than a minimum wage, did not change much in the study period (Table 5).

The Research and Policy Interface

Ceará is located in the poor semiarid region of Brazil, affected by severe droughts every few years. The socio-economic and environmental situation in Ceará did not change markedly between 1987 and 2007, yet there were remarkable improvements in child health. These accomplishments may be attributed to the work of a large team of players, with a fruitful interaction of policy makers and researchers. The new government elected in Ceará in 1986, chose the reduction of child mortality as a high priority, and a new program called "Viva Criança" (Let Children Live) was created with the support of UNICEF, being an integral part of a master plan (Table 6).

The Program invited two epidemiologists to work with the local team (Victora, CG and Barros, FC). There was a need for good quality information to help select priorities and a state-wide survey was designed to measure indicators of child health and socioeconomic status.

The child health team was very motivated knowing that their actions would be evaluated by a second survey 4 years later. The first study surveyed about 4,000 children, from urban and rural areas and its total cost was US $40,000, a relatively small amount for such a large study.

About 50 indicators were collected through a questionnaire, and all children were weighted and measured. The 1987 survey revealed that half of all child deaths were due to diarrhea, and that 12 % of all children had diarrhea on the day of the interview, but only 23 % used oral rehydration. Diarrhea was then elected as the main focus on child health in the State, with a Diarrhea Control Program been launched.

Data were broken down by family income groups, revealing marked socioeconomic differentials in coverage of the key child care actions. The need to reach the poorest families led to the creation of the first large-scale program of community health workers (CHW) in Brazil. Thus, in

1988, 6,000 CHW's were recruited and trained. The formal health services were also involved, with a large number of doctors and nurses being trained on ORT, and 260 health facilities were equipped with 'ORT corners', where mothers themselves could provide oral rehydration to their children. Mass media campaigns were used to increase awareness on diarrhea, using radio, television, theatre groups, among others. One million measuring spoons for preparing sugar-salt solution were manufactured and distributed [14]. In addition, packets of ORS were distributed at facilities and by CHW, free of charge.

Three years after the first survey, the new questions asked by policymakers to the evaluators were: did these measures work? Did the coverage of ORT increase? Were the interventions able to reach the poorest families? Did mortality due to diarrhea decrease?

The actions taken were indeed effective. The second survey, in 1990, showed that the proportion of deaths due to diarrhea decreased markedly, from 48 to 32 %. There was also a slight decline in diarrhea prevalence (from 30 to 25 %) and a larger decline on hospital admissions in the previous 12 months, from 4.6 to 3.3 %. Use of ORS increased from 23 to 32 %. The major success against diarrhea deaths suggested that the diarrhea case management improved reducing case-fatality, although the prevalence remained high. In the following survey of 1994 diarrhea deaths accounted for only 24 % of the total, and the use of ORS reached 50 %, a plateau that was kept in the coming years.

Achieving high and equitable vaccination coverage was also a priority. By 1987, only half of all children aged between 12 and 23 months had received DPT vaccine, with an important social gradient. Important investments were made in increasing coverage, by improving the cold chain and equipping all health facilities to provide fulltime vaccination. In addition, routine vaccination was promoted through mass media campaigns that included broadcasting of radio/TV messages, distribution of folders by home deliveries companies, printing messages on supermarkets and department stores plastic bags etc. New approaches, such as the provision of routine BCG at birth in the maternities, were also introduced. CHW routinely checked child's vaccination cards. As a result of such an effort, the state that was ranked last among the 27 Brazilian States in terms of vaccine coverage in the 1980s, currently is in third place, with the act of vaccination being strongly incorporated to the local child care culture. Further on, new types of vaccine were added to the basic immunization scheme, such as the HiB and the rotavirus vaccine.

Perinatal and neonatal causes of death became relatively more important in the second survey of 1990. This led to an effort to increase the antenatal and delivery care coverage, with the implementation of the "Viva Mulher" program (Let Women Live) in 1992. While in 1987 only 65 % of the women had any antenatal care, current coverage is almost universal. By 2001, almost all women delivered in a hospital, while delivery of the baby by doctors, increased from 37 to 61 %.

Still in 1990, the survey detected that breastfeeding duration was very short, and exclusive breastfeeding was almost non-existent. Thus, 6,000 health workers were trained on breastfeeding and major mass media campaigns were run on television, radio and newspapers. Twenty seven 'Baby-Friendly Hospitals'—large maternities that promote breastfeeding already in the delivery rooms—were established, and Ceará is now the leader of this initiative in Brazil. Among the creative approaches was the promotion of photograph contests of breastfed babies. To help mothers with breastfeeding difficulties, Human Milk Banks were created in the larger maternities of the Capital city and Interior. As result of such efforts, exclusive breastfeeding improved rapidly. While in 1987 <1 % of the infants were exclusively breastfed, in 2007 about 30 % of infants below 4 months old were being exclusively breastfed. In 2007, half of children were still breastfed at the ages of 12–15 months, while the proportion at 1987 was only one at every four children.

Stunting prevalence declined by half since 1987. Underweight declined by three quarters, and is now at 4 %. These reductions were sufficient for reaching the first Millennium Development Goal aimed at eradicating poverty and hunger, which has as one of its indicators a reduction of 50 % in child underweight between 1990 and 2015. Recently, the effectiveness of growth monitoring in improving nutrition has been challenged [15], and it is likely that in Ceará nutrition improved due to several factors, including infection control through immunization and case-management, improved water and sanitation, decreased family size and women's education [16].

An important aspect of the experience in Ceará was that mass campaigns and vertical programs were used when necessary, but the cornerstone of all the efforts were the strengthening of health services and information systems, as measures which are sustainable in the long term. From 1995 onwards, 1,300 Family Health Teams were established, each with one doctor, one nurse, four nursing assistants and six CHW. In total, 10,000 CHW were trained by a School of Public Health, created with this purpose. An information system was developed utilizing data from the home visits by the CHW, including information on mortality, morbidity, nutrition and intervention coverage.

Discussion

The achievement of MDG 4 in Ceará is made evident not only by the reduction of the rate itself, but also by the

changing patterns of infant mortality. Today, diarrheal diseases and pneumonia together account for only about 10 % of the deaths, while 20 years before they were the main causes, responsible for over half of the whole infant deaths. This drastic reduction on unnecessary deaths led to the relative increase in perinatal causes, which now account for 76 % of infant mortality. Changes in broad social determinants of health over this period were not neatly observed. At least until 2007, income levels or its distribution did not improve. Water supply and sanitation improved, but mainly in urban areas. On the other hand, Ceará was successful on getting important achievements on critical areas of child care, such as use of ORT, vaccination, growth monitoring, breastfeeding, access to health through formal and non-formal resources. Achievements in terms of reproductive and maternal health also contributed, as shown by the reduction of the fertility rates, and the improvements on antenatal and delivery care. Improvement in maternal education, reflected by the increase of the years of schooling, must have contributed to the reduction of infant deaths, as it is essentially linked to the better provision of child care [17–19].

Due to its success in improving maternal and child health, the State was awarded in 1994 with the 'Maurice Pate Award', an international annual prize given by UNICEF. This prize was earned by the policy makers and health workers from Ceará, and was the rigorous measurement of child health indicators through the repeated surveys, which allowed documenting the impact of their actions.

An important aspect of the whole process was that local capacity was also built with the studies. The 1987 survey was designed, supervised and analyzed by researchers not from Ceará state. They trained local researchers, so that in 1990 the local team did all the survey planning and implementation, but still required help with data analyses. The 1994, 2001 and 2007 surveys were carried out by a local team.

Analyzing this 20-year experience, politics was always a key element. Child survival was identified as a political issue, and five consecutive state governments promoted actions to improve child health. There was a clear long-standing commitment to improving health systems, but at the same time there were efforts to approach the hard-to-reach families through CHW, the school system, the mass media, and many other alternative delivery channels. Integration was also a key element. Preventive and curative actions were delivered in an integrated way, and child health was never considered separately from reproductive and family health issues. Also, the central team that led what was called the 'Ceará child survival revolution' counted with highly motivated and technically competent pediatricians, who received support from a strong evaluation team, initially from other states but later from within

Ceará. Thus, the efficient capacity building for services delivery was guided by large scale impact evaluations. Finally, governors and policy makers advertised their success broadly. One may even ask if the improvements in child health contributed to the reelection of the same political party on four consecutive polls.

Similar to Ceará state, several countries have achieved successes in combating extreme poverty and hunger, improving school enrolment and child health, expanding access to clean water, strengthening control of malaria, tuberculosis and neglected tropical diseases, and providing increased access to HIV treatment (*Millennium Development Goals: At a Glance*). These successes occurred in some of the poorest countries, demonstrating that the MDGs are indeed achievable with the right policies and adequate levels of investment. The shortfalls in progress towards the MDGs seem not to be because they are unreachable, or because the time is too short, but rather because of unmet commitments, inadequate resources and lack of focus and accountability [16]. This was exactly what did not occur in Ceará state in northeast Brazil.

In summary, in the period from 1987 to 2007, the socioeconomic and environmental situation in Ceará did not change much, but there were major improvements in child health contributing substantially to the progress on MDG 4 in Brazil. A series of five population based surveys produced reliable information that allowed policymakers to plan and evaluate their actions, thus contributing to the remarkable progress made by the state.

References

1. Bhutta, Z. A., Chopra, M., Axelson, H., Berman, P., Boerma, T., Bryce, J., et al. (2010). Countdown to 2015 decade report (2000–10): Taking stock of maternal, newborn, and child survival. *Lancet, 375*(9730), 2032–2044.
2. Rai, R., Ramadhan, A., & Tulchinsky, T. (2012). Prioritizing maternal and child health in independent South Sudan. *Maternal and Child Health Journal, 16*(6), 1139–1142. (English).
3. Victora, C. G., Aquino, E. M., do Carmo Leal, M., Monteiro, C. A., Barros, F. C., & Szwarcwald, C. L. (2011). Maternal and child health in Brazil: Progress and challenges. *Lancet, 377*(9780), 1863–1876.
4. UNICEF. (1992). Situação Mundial da Infância. Ceará: Mostrando o que pode ser feito. Brasília [1993].

5. Maier, J. (1991). Fewer bells for the little angels: One of the poorest areas in Brazil shows the rest of the world how to reduce infant mortality dramatically. *Time Magazine*.

6. Emerson, T., & Kepp, M. (1991). The land of blue crosses: How a poor Brazilian state saves babies' lives. *Newsweek Magazine*.

7. Taylor, Y., & Nies, M. (2013). Measuring the impact and outcomes of maternal child health federal programs. *Maternal and Child Health Journal, 17*(5), 886–896. (English).

8. Victora, C. G., Vaughan, J. P., Barros, F. C., Silva, A. C., & Tomasi, E. (2000). Explaining trends in inequities: Evidence from Brazilian child health studies. *Lancet, 356*(9235), 1093–1098.

9. Victora, C. G., Barros, F. C., Tomasi, E., Ferreira, F. S., Macauliffe, J. F., Silva, A. C., et al. (1991). Child health in the States of Ceará, Rio Grande do Norte and Sergipe, Brazil: Description of a methodology for the diagnosis of communities. *Revista de Saude Publica, 25*(3), 218–225.

10. BRASIL, Ministério da Saúde. (2010). Saúde Brasil 2009: Uma análise da situação de saúde e da agenda nacional e internacional de prioridades em saúde. Brasília.

11. Barros, F. C., & Victora, C. G. (1991). *Epidemiologia da saúde infantil: Um manual para diagnósticos comunitários* (p. 176). São Paulo: HUCITEC/UNICEF.

12. State of Ceará Secretariat for Health. (2001). *IV Pesquisa de Saúde Materno-Infantil do Ceará: Relatório final 1987–2001*. Fortaleza: State of Ceará Secretariat for Health.

13. State of Ceará Secretariat for Health. (2008). *V Pesquisa de Saúde Materno-Infantil do Ceará: 20 anos de acompanhamento, 1987–2007*. Fortaleza: State of Ceará Secretariat for Health.

14. Barros, F. C., Victora, C. G., Forsberg, B., Maranhão, A. G., Stegeman, M., Gonzalez-Richmond, A., et al. (1991). Management of childhood diarrhoea at the household level: A population-based survey in north-east Brazil. *Bulletin of the World Health Organization, 69*(1), 59–65.

15. Roberfroid, D., Kolsteren, P., Hoeree, T., et al. (2005). Do growth monitoring and promotion programs answer the performance criteria of a screening program? A critical analysis based on a systematic review. *Tropical Medicine and International Health, 10*, 1121–1133.

16. Garner, P., Panpanich, R., & Logan, S. (2000). Is routine growth monitoring effective? A systematic review of trials. *Archives of Disease in Childhood, 82*, 197–201.

17. Monteiro, C. A., Benicio, M. H., Konno, S. C., Silva, A. C., Lima, A. L., & Conde, W. L. (2009). Causes for the decline in child under-nutrition in Brazil, 1996–2007. *Revista de Saude Publica, 43*, 35–43.

18. Gakidou, E., Cowling, K., Lozano, R., & Murray, C. J. (2010). Increased educational attainment and its effect on child mortality in 175 countries between 1970 and 2009: A systematic analysis. *Lancet, 376*(9745), 959–974.

19. United Nations. (2010). http://www.un.org/millenniumgoals/pdf/mdg_pressrel_sept2010.pdf. Accessed 25-10-2010.