Acta Paulista de Enfermagem
ISSN: 0103-2100
ape@unifesp.br
Universidade Federal de São Paulo
Brasil

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Acta Paulista de Enfermagem, vol. 29, núm. 3, 2016, pp. 282-290
Universidade Federal de São Paulo
São Paulo, Brasil

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Mortalidade infantil: tendência temporal e contribuição da vigilância do óbito

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Keywords
Infant mortality; Epidemiological surveillance; Public health nursing; Maternal-child nursing; Pediatric nursing

Descritores
Mortalidade infantil; Vigilância epidemiológica; Enfermagem em saúde pública; Enfermagem materno-infantil; Enfermagem pediátrica

Submitted
December 3, 2015

Accepted
July 30, 2016

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DOI
http://dx.doi.org/10.1590/1982-0194201600040

Abstract

Objective: To analyze the temporal trend in infant mortality in the city of Recife, state of Pernambuco, Brazil and evaluate the contribution of death surveillance as an instrument for improving vital statistics and action planning.
Methods: Infant, neonatal, and post-neonatal mortality rates were calculated from 1980 to 2012. An exponential regression model was used for trend analysis. A study on the variables, the basic and associated causes of death certificates, and avoidability was conducted to evaluate the contribution of infant death surveillance.
Results: The trend in infant mortality rate and its age components was shown to be decreasing. After research on infant death surveillance, no death certificate variable remained incomplete, and the underlying cause of death was better determined in 52% of deaths. Almost 80% of deaths were classified as preventable, and 51.3% were classified as reducible by appropriate care provided to women during their pregnancy.
Conclusion: Infant mortality presented a decreasing trend, and infant death surveillance contributed to improve vital statistics, which are essential for maternal-infant health planning actions.

Resumo

Objetivo: Analisar a tendência temporal da mortalidade infantil na cidade de Recife, Pernambuco, Brasil e avaliar a contribuição da vigilância do óbito como instrumento para aprimoramento das estatísticas vitais e planejamento de ações.
Métodos: Foram calculados os coeficientes de mortalidade infantil, neonatal e pós-neonatal para o período de 1980 a 2012. Utilizou-se o modelo de regressão exponencial para análise da tendência. Para avaliar a contribuição da vigilância do óbito infantil foi realizado um estudo sobre as variáveis, causas básicas e associadas da Declaração de Óbito, e da evitabilidade.
Resultados: A tendência do coeficiente de mortalidade infantil e seus componentes etários foram decrescentes. Após a investigação da vigilância do óbito infantil nenhuma variável da Declaração de Óbito ficou incompleta e, em 52% dos óbitos, a causa básica foi melhor definida. Quase 80% dos óbitos foram classificados como evitáveis e 51,3% reduzíveis por adequada atenção à mulher na gestação.
Conclusão: A mortalidade infantil apresentou tendência decrescente e a vigilância do óbito infantil contribuiu para aprimorar as estatísticas vitais, fundamental para o planejamento das ações de saúde materno-infantil.

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Conflicts of interest: there are no conflicts of interest to declare.

Introduction

Infant mortality is an important women's and children's health indicator; it is considered a sentinel event due to its avoidability.[1,2] It is associated with bio-sociocultural and care determinants, and its reduction depends on effective improvement in life conditions and public health policies.[3] Failures in the care provided to pregnant women, childbirths, and newborns are particularly relevant to death occurrences in the first year of life.[4]

Infant deaths remain a public health problem worldwide, especially in poorer countries and regions. Therefore, the World Health Organization considers the reduction of infant mortality by two-thirds to be one of the eight millennium developmental goals to be achieved by 2015.[5] There were significant advances in Brazil, with the infant mortality rate (IMR) decreasing from 26.1 per 1,000 live births in 2000 to 14.0 per 1,000 live births in 2011, with a total reduction of 41.5% within this period.[6,7]

Nonetheless, problems remain to be overcome, such as regional, state, and municipal differences because of social inequalities that exclude significant population contingents from access to basic goods and services,[3] with more death risks in populations in the North and Northeast regions. The Northeast region reached the highest reduction in IMR, changing from 35.9 deaths per 1,000 live births in 2000 to 20.3 in 2010. However, rates still remained above the national mean. In the state of Pernambuco, the IMR in 2000 was 34.0 per 1,000 live births, reduced to 18.1 per 1,000 live births in 2010, a reduction of 46.8%[6]

Brazilian success regarding the millennium goal for infant mortality resulted from the unquestionable reduction in poverty observed over the last few years, due to cross-sector compensatory public policies, such as the Brazilian *Programa Bolsa Família*.[3,8] In the health sector context, the expansion of the Brazilian Family Heath Strategy (ESF, as per its acronym in Portuguese) contributed to strengthening primary health actions, especially those directed to women, family and prenatal planning, and children, by means of incentives to breastfeed, immunizations, and care for childhood-prevalent diseases. Moreover, a significant reduction in fertility occurred, favoring the decline in infant mortality.[3,9]

In addition to collective and individual activities directly related to care, Brazil has been developing health surveillance actions, such as research on deaths, which may contribute to a better understanding of death determinant chains, especially those that are preventable.[10] Although death surveillance is considered a good indicator of healthcare systems' effectiveness,[11] the Brazilian Ministry of Health made it compulsory only in 2010, aiming at improving the quality of vital information and promoting reflections for workers and managers in the care provided to women and children.[2]

The objective of the present study was to analyze temporal trends in infant mortality in the city of Recife, state of Pernambuco, Brazil, and evaluate the contribution of death surveillance as an instrument for improving vital statistics and action planning.

Methods

The study was conducted in Recife, capital city of the state of Pernambuco, located in the Northeast region of Brazil, with an area of 218.5 km². It has the fourth most populated urban concentration in the country, distributed in 94 neighborhoods and six health districts (HD), and a population of 1,617,183 inhabitants.[12] A temporal trend study in IMR and its neonatal and post-neonatal components (per 1,000 live births) was conducted from 1980 to 2012. For coefficient calculation, the number of deaths originated from the Brazilian Mortality Information System database (SIM, as per its acronym in Portuguese) in the whole period. Live birth data were obtained from two sources: from 1992 to 2012, from the Brazilian Live Births Information System (SINASC, as per its acronym in Portuguese) and, in previous years (1980-1991), from official estimates of the number of live births prior to the establishment of the SINASC.

Temporal trends in IMR and its components were analyzed by means of the exponential regression model ($Y=\beta\ e^{\beta_1 X}$), where Y is the mortality coefficient (dependent variable), X the corresponding year (independent variable), β_0 the mean coefficient of the period, and β_1 the value of the annual mean exponential increase in the series studied. To minimize the autocorrelation among points, a centralized X variable was adopted (calendar year-mean series year), with 1996 as the mean point of the period. The trend was considered significant when $p<0.05$, and a determination coefficient (r^2) was used to evaluate the model's explanatory power (the closer to 1, the better). The Statistical Package for Social Sciences 21 program (SPSS) was used for data analysis.

In addition, a cross-sectional study with data on the 275 infant deaths that occurred in 2012 was conducted. All of the specific variables of infants under the age of one contained in death certificates were analyzed, in addition to basic, associated, and preventable causes of death. This instrument was composed of 59 variables distributed in nine blocks: identification; residential address; place of death occurrence; fetal or infant death characteristics; conditions and causes of death; certifying physician; data of external causes; register's office; and locality without physician.[1]

Recommendations of the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) were followed for the definition of basic, intermediate, or immediate causes of death, where part I of the death certificate is intended for noting the cause of death (terminal cause-line A), morbid conditions that generated the cause recorded in line A (intermediate causes-previous or consequential-lines B and C), and the basic cause-line D. Part II is intended to record other significant morbid conditions that contributed to the fatal event, but were not part of the chain defined in part I.[13]

In the analysis of avoidability, the list of preventable causes of deaths by interventions of the Brazilian Unified Health System (SUS, as per its acronym in Portuguese) was adopted, where deaths are classified as: preventable (reducible by immunization actions, appropriate care to women during pregnancy and childbirth and to newborns, and appropriate diagnosis and treatment actions); non-preventable; and ill-defined.[14]

Each variable was collected in two periods, before and after the undertaking of the infant death surveillance which, in the city of Recife occurs in four stages: identification of infant deaths; epidemiological research; discussion of deaths; and referral to promotion proposals, health care, and correction of vital statistics. The infant death surveillance is made up of a multidisciplinary team, whose research is performed by the primary care and/or HDs professionals who check outpatient medical records and carry out face-to-face household interviews. Hospital studies are conducted by the district's team and hospital epidemiology centers, and in necropsy services by the central level team.

In this stage, a properly confidential form is used, which includes all variables recommended by the Brazilian Ministry of Health (MS, as per its acronym in Portuguese) regarding: infant and mother identification; family characteristics; pregnancy data; prenatal data; birth data; child-care data; outpatient and hospital care of pregnant woman and child data; and death occurrence data.[1,2] The discussion is undertaken with the participation of healthcare, surveillance, and management professionals, and propositions are forwarded to healthcare managers for proper arrangements.

Death cause data were obtained through the SIM, and the other variables were collected by consulting birth certificates. A ratio of deaths with ignored or blank variables before and after the undertaking of the infant death surveillance was obtained, and the ratio of variables rectified with this procedure. Categories of preventable death causes were compared before and after infant death surveillance by means of Pearson chi-square test ($p<0.05$).

The study was registered in the Plataforma Brasil under Certificate of Presentation for Ethical Consideration (CAAE, as per its acronym in Portuguese) no. 07336313.6.0000.5190.

Results

The IMR and its age, neonatal, and post-neonatal components presented a decreasing temporal trend (p<0.05), with a coefficient of determination ranging between 0.93 and 0.96. The post-neonatal mortality rate (PNMR) showed a more significant decreasing exponential trend than other coefficients analyzed (Figure 1).

In the first decade studied, a drop of 26.8% in IMR was found, which ranged from 77.6 per 1,000 live births in 1980 to 56.8 per 1,000 live births in 1989, with a more significant decline in the post-neonatal component. For the second decade (1990 to 1999), reduction in IMR was more significant (52.4%). Post-neonatal component decreased from 21.5 per 1,000 live births (1990) to 6.4 1,000 live births (1999), with a reduction of 70.2%. Similar decline in IMR, neonatal mortality rate (NMR) and PNMR were found between 2001 and 2012, on the order of 33.0%, 34.6%, and 30.0%, respectively (Figure 1).

The incompleteness mean of death certificate variables of infants under the age of one before research was 11.1%. After research, an absence of variables with ignored or incomplete filling out of forms was found. It is worth noting that the death certificates variables "received medical care", "necropsy", "birth certificate number," and "weeks of pregnancy" decreased from 32.7%, 30.5%, 27.3%, and 19.6% incomplete, respectively, to 0% - that is, a complete filling. Moreover, a significant rectification percentage in the filling of all variables analyzed after the infant death surveillance was found, highlighting the number of live births

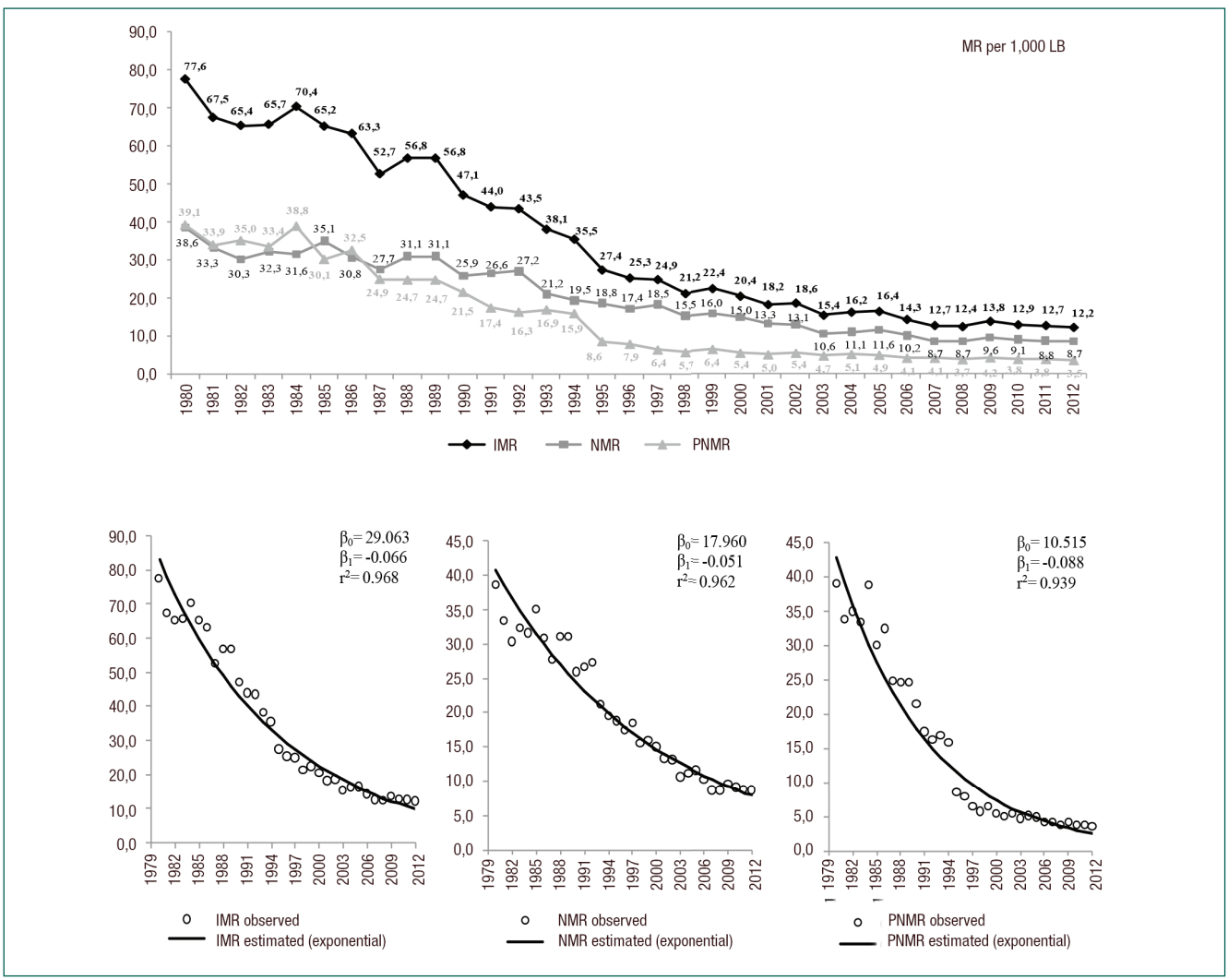

Figure 1. Infant mortality rate and exponential regression models according to age component and year of occurrence

(48.7%), number of weeks of pregnancy (41.8%), and residential address (37.5%) (Table 1).

After undertaking the infant death surveillance, rectifications in all items of basic and associated causes recorded in parts I and II of the birth certificates were found, with a change in the basic cause in 52% of deaths. In part I, rectifications were on the order of 41.7% (Line A), 61.9% (Line B), 71.9% (Line C), and 77.0% (Line D), and 91.1% in part II of the death certificates.

Deaths in infants under the age of one classified as preventable before (78.2%) and after the undertaking of the infant death surveillance (77.1%), remained with similar percentages. Ill-defined causes were completely clarified after research. Among deaths in the preventable causes group, changes were more significant in some categories, such as reducible deaths with appropriate care provided to women during pregnancy and newborns, changing from 39.3% to 51.3% and 16.0% to 5.5%, respectively (Table 2).

The research defined reducible causes by care provided to women during pregnancy with higher accuracy, with increases in maternal conditions and pregnancy complications from 14.5% to 29.8% and 8.4% to 14.2%, respectively, in detriment to intermediate or immediate causes of death, previously classified as basic causes. Ratios of maternal conditions, maternal hypertensive disorders, maternal urinary tract infections, and cervical insufficiency nearly almost doubled, increasing from 7.2% to 13.1%, 5.8% to 11.6%, and 2.2% to 4.7%, respectively, after research (Table 2).

Intermediate causes regarding more specific causes, such as complications of placenta and membranes, were reduced from 5.1% to 1.8%. Disorders associated with short-term pregnancy and low birth weight were reduced from 5.8% to 0.4%; from hypoxia/perinatal asphyxia from 4.0% to 1.8%; and from infections during the neonatal period from 5.5% to 1.5% (Table 2).

Table 1. Completeness and rectification of death certificate variables, before and after undertaking infant death surveillance

Death certificates variables	Death certificates completeness		DC rectification after infant DS rectified n(%)
	Before IDS Ignored/Blank n(%)	After IDS Ignored/Blank n(%)	
Characteristics of the mother			
Age	23(8.4)	-	36(13.1)
Education level	25(9.1)	1(0.4)	41(14.9)
Occupation	29(10.5)	1(0.4)	51(18.5)
Characteristics of pregnancy and childbirth			
No. of live births	22(8.0)	-	134(48.7)
No. of fetal losses/abortions	33(12.0)	-	47(17.1)
No. of weeks of pregnancy	54(19.6)	-	115(41.8)
Type of pregnancy	19(6.9)	-	22(8.0)
Type of childbirth	20(7.3)	-	21(7.6)
Characteristics of the child			
Age	3(1.1)	-	9(3.3)
Gender	1(0.4)	1(0.4)	2(0.7)
Race/Color	7(2.5)	14(5.1)	7(2.5)
Birth weight	29(10.5)	-	39(14.2)
Address	6(2.2)	1(0.4)	103(37.5)
No. of BC	75(27.3)	-	85(30.9)
Death characteristics			
Establishment	1(0.4)	-	15(5.5)
Received medical care	90(32.7)	-	90(32.7)
Necropsy	84(30.5)	-	84(30.5)

IDS-Infant Death Surveillance; DC-Death certificate; DS-Death surveillance; BC-Birth certificate

Table 2. Comparison of death avoidability classification of infants under the age of one, before and after the undertaking of infant death surveillance

Avoidability	Original cause n(%)	Cause after infant DS n(%)
Preventable causes (p=0.001)*	215(78.2)	212(77.1)
1. Reducible by care provided to women during pregnancy (p<0.001)*	108(39.3)	141(51.3)
Congenital syphilis (A50.0, A50.2)	1(0.4)	3(1.1)
Maternal conditions, not necessarily associated with current pregnancy		
Maternal pregnancy complications		
Cervical insufficiency (P01.0)	6(2.2)	13(4.7)
Premature rupture of membranes (P01.1)	12(4.4)	17(16.2)
Other complications (P01.2-P01.9)	5(1.8)	9(3.3)
Complications of placenta and membranes (P02.2, P02.3, P02.7)	14(5.1)	5(1.8)
Disorders associated with short-term pregnancy and low birth weight (P07.1, P07.2)	16(5.8)	1(0.4)
Other causes (P05.9, P22.0, P26.9, P77)	14(5.1)	11(4.0)
2. Reducible by appropriate care provided to women in childbirth (p=0.254)*	22(8.0)	19(6.9)
Placenta previa and placenta abruption (P02.0, P02.1)	5(1.8)	8(2.9)
Hypoxia/perinatal asphyxia (P20.1, P20.9, P21.0, P21.1, P21.9)	11(4.0)	5(1.8)
Other causes (P02.5, P03.0, P24.0, P24.9)	6(2.2)	6(2.2)
3. Reducible by appropriate care provided to newborns (p=0.012)*	44(16.0)	15(5.5)
Respiratory ailments specific to neonatal period (P22.9, P23.9, P25.1, P25.2, P27.1, P28.0, P28.5)	27(9.8)	6(2.2)
Infections of neonatal period (P36.9, P37.8, P39.9)	15(5.5)	4(1.5)
Other causes (P59.3, P70.0, P78.8, P96.4)	2(0.7)	5(1.8)
4. Reducible by diagnosis and appropriate treatment actions (p=0.525)*	20(7.2)	20(7.2)
Respiratory infections (J18.0, J18.1, J18.9, J21.9)	12(4.3)	10(3.6)
Other causes (P41.8, P41.9, P00.1, Q90.9)	8(2.9)	10(3.6)
5. Reducible by health promotion actions (p=0.906)*	21(7.7)	17(6.2)
Diarrhea of probable infectious origin (A09)	5(1.8)	5(1.8)
External causes (W78.0, W78.9, W80.0, X91.9, X95.9, Y21.0, Y21.9, Y34.9)	15(5.5)	11(4.0)
Sudden infant death syndrome (R95)	1(0.4)	1(0.4)
Ill-defined causes	2(0.7)	-
Other causes (not clearly preventable) (p<0.001)*	58(21.1)	63(22.9)
Total infant deaths	275(100.0)	275(100.0)

*χ2 Pearson; DS-Death surveillance

Discussion

A significant decline in infant mortality in the city of Recife occurred from 1980 to 2012. Therefore, with the reduction in preventable deaths, the infant mortality levels began to drop more slowly in the series' last few years,[14] demanding improvement in the quality of care provided by health services, in addition to a decrease in existing social contrasts in Brazil.

The following factors stand out among the main contributing factors for the reduction of mortality in the decade 1980-1989: advances in medical technologies (especially immunization and oral rehydration therapy); an increase in breastfeeding; increases in basic sanitation; decreases in fertility; and an increase in prenatal care and hospital childbirth coverage. In the following decade, a general improvement in living conditions, food and nutrition safety, women's educational levels, an increase in primary

care coverage, and greater access to healthcare services were added the abovementioned factors.[3,9,15]

Similar declines in mortality rates remained for the last period (2001 to 2012). Nonetheless, the NMR prevailed differently from what occurred in most of the Brazilian cities and states, where the annual decrease in neonatal mortality was 3.2% from 2000 to 2008, considerably lower than the PNMR (8.1%).[3,5] In the Northeast region, in this same period, reduction in the NMR was 34.8%, whereas in the PNMR it was 59.4%. These figures are repeated in all states of the region.[12] Maintenance of the decline in mortality trend might be associated with the improvement of primary care quality, an increase in ESF coverage, and qualification of childbirth and birth care.[3,9,15,16] Despite significant advances, however, iniquities in access and quality of care among population groups and the country's territories remain.[7,16]

In addition to cross-sector public policies and healthcare actions and programs, new strategies for the reduction of infant mortality have been proposed,[17] such as infant death surveillance. This initiative has favored the understanding of circumstances where the event occurred. This has not always contributed to the correction of failures described in vital statistics, although some informative data were produced.[11,18] Studies related to the quality and filling of sociodemographic, reproductive, and care variables, as well as death causes, showed high incompleteness ratios and an insufficient definition level of causes recorded in death certificates.[6,19-22] The quality of data recorded in death certificates depends on access to health services, technologies for diagnosis, and physicians' ability to recognize the dynamics of events that participated in the causal chain of deaths, as well as physicians' commitment to the production of reliable statistics. The training of these professionals, who have an ethical and legal responsibility for completing death certificates, is an important strategy for the improvement of SIM's data.[6,20,21]

Infant death surveillance contributed to improvements in completing death certificates, validating information on variables, and reducing the ratio of blank and ignored data, in addition to improving the specification of basic and associated causes of infant deaths. In several studies on death certificate completeness, gender, age, residential address, and place of death variables presented the best fillings.[19,23,24] After the undertaking of infant death surveillance in the city of Recife, the variables were totally filled, thus contributing to the accurate diagnosis of the health situation, as well as better planning and decision-making based on evidence.[14,19,22]

Regarding recommendations associated with health promotion, care to avoid new deaths, and corrections in the filling of birth and death certificates identified in the research, discussions around deaths are carried out and directed to those who are interested.[1,2]

Rectification of the basic causes in more than half of all infant deaths occurred, and this was also important. It enabled a better framework for avoidability classification, with an important repercussion on actions to be recommended to overcome the high infant mortality rate. An example of this situation was the contribution of infant death surveillance to changes in reducible deaths by appropriate care provided to women during pregnancy and subsequently to newborns, indicating the need for investment in prenatal care, not only in terms of increased access, but with improvements in quality.[14]

Increases in the identification of maternal conditions and pregnancy complication ratios, which are associated with maternal hypertensive disorders, urinary tract infections, and cervical insufficiency, almost doubled after the research, reducing intermediate causes. Maternal conditions and pregnancy complications are often associated with prenatal care quality and, if properly identified and cared for, they may increase newborns' chances of survival and reduce risks and harm to maternal-infant health.[4,14,25-27]

In contrast to the identification of death associated with maternal conditions, reducible deaths by appropriate care provided to newborns in terms of intermediate causes, such as disorders associated with short-term pregnancy and low birth weight, and hypoxia/perinatal asphyxia, decreased after the research regarding specific causes. Causes such as perinatal asphyxia and intrauterine hypoxia are syndromic manifestations resulting from other conditions that must be identified for prevention and appropriate treatment.[28]

Conclusion

Infant, neonatal, and post-neonatal mortality rates in the city of Recife showed decreasing trends from 1980 to 2012. Infant death surveillance was considered an important instrument through its contribution to the improvement of vital statistics, reduction in incompleteness of birth certificate variables, rectification of data, and better establishment of basic and associated causes, with consequent changes in the classification of death avoidability. The correction of these indicators is essential for the improvement of health policies and programs aimed at reducing infant mortality.

Acknowledgements

To the National Council for Scientific and Technological Development (CNPQ, as per its acronym in Portuguese) under Process no. 480718/2012-1, and the Foundation for Science and Technology of the State of Pernambuco (FACEPE, as per its acronym in Portuguese) under Process no. 2133-4.012 for enabling the development of this study.

Collaborations

Oliveira, Bonfim, and Guimarães declare that they contributed to the project conception, data analysis, and interpretation, as well as the writing of the article and final approval of the version to be published. Frias and Medeiros declare that they contributed to the critical review of the intellectual content and final approval of the version to be published.

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