Infant mortality in southern Brazil: a population based study of causes of death

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SUMMARY  The causes of 215 infant deaths occurring in a population based cohort of 5914 infants from southern Brazil were determined. Perinatal problems were responsible for 43% of these deaths and infectious diseases for 32%. In the group who died of infectious diseases, respiratory infections and diarrhoea were equally important, each accounting for 12% of all deaths.

A total of 87% of the deaths occurred in the first six months of life, and this proportion remained high (77%) even after perinatal causes had been excluded. On the other hand, 53% of the infants who died were of low birth weight, as opposed to 7.9% of the survivors. This suggests that low birthweight infants need to be carefully followed by health workers at primary level, especially during the first six months.

It was estimated that if the incidence of low birth weight was reduced from the present 8.8% to 5% the likely reduction in infant mortality would be 20%. This reduction would be 33% for deaths due to perinatal causes, 14% for respiratory infections, and only 5% for diarrhoea.

Efforts for the prevention of infant deaths in southern Brazil are more likely to be effective if they concentrate on improving perinatal health care and environmental conditions.

The prevention of infant mortality is widely recognised as a social and health priority in developing countries. For many of these countries, however, important information about infant deaths, which is much needed for effective prevention, is not available. Ashworth and Waterlow reviewed this subject in 1982 and were unable to find any national data on infant mortality from developing countries except for the inter-American study published in 1973. These authors emphasised that more information is needed about the causes of deaths and age distribution of infant mortality.

Reasons for the paucity of information include the lack of population based epidemiological studies of infant mortality in developing countries and the poor quality of vital statistics. In the latter case the data are often unsatisfactory because of under registration, the poor ascertainment of causes of death, and the lack of information about potentially important risk factors, such as birth weight.

A longitudinal study of child health has been in progress since 1982 in the city of Pelotas in southern Brazil (population 210 000), and 5914 children are being followed from birth. The study of this cohort allowed us to analyse specific aspects of infant mortality. In this paper we attempt to answer the following questions:

(a) What are the causes of infant deaths?
(b) What is the age distribution of deaths due to different causes?
(c) What is the role of low birth weight in deaths due to different groups of causes?

A better understanding of these issues may help health planners to focus on infants who are at greatest risk.

Patients and methods

The study cohort comprised all 5914 liveborn babies delivered in the three hospitals in Pelotas in 1982 whose mothers lived in the urban area. These represented more than 99% of all births that occurred in the city that year. All mothers were interviewed soon after delivery and their babies were followed up during their stay in hospital. As babies are discharged from hospitals very early (23% within 24 hours) it was necessary to visit a 20% random sample of them at home after one week of life to check their state of health after the perinatal period.
In early 1984 we attempted to find all children through home visits, when their ages ranged between 12 and 27 months (average 20 months). As a high proportion of families had moved within the city since the children had been born, all 69,000 households in the city had to be visited in search of children born in 1982.

During home visits information on infant deaths was solicited. In addition, we surveyed all deaths reported at hospitals, registries, and health authorities in Pelotas, as well as in neighboring cities and the state’s capital. Causes of death were determined by reviewing hospital case notes, death certificates, and necropsy reports, as well as by interviews with relatives of the dead children during home visits.

Deaths were grouped into the following causes according to the International classification of diseases: perinatal (ICD codes 760–779-9), malformations (ICD codes 740–759-9), respiratory infections (ICD codes 460–519-9), diarrhea (ICD codes 001-009-3), other infections (ICD codes 010–139-8), 320–325.382,383,573-3,590,595,599,680–686), ill defined (ICD codes 780–799-9), and other causes.

The denominators (infant years at risk) for the rates presented below were calculated by actuarial methods, assuming that infants who were not located had been followed for half a year. Confidence intervals for the relative risks were calculated by Miettinen’s method.

## Results

Of the original cohort of 5914 babies, 233 were found to have died (215 of whom died in the first year). A total of 750 (13%) could not be located, and so 4931 babies were examined. The infant mortality was 38.8 per 1000 live births. The neonatal and post-neonatal mortalities were 21.5 and 17.3 per 1000 live births, respectively. The official infant mortality calculated by the State’s Secretary of Health was 24% lower, due to under registration of infant deaths.

### Causes of Infant Death

Perinatal causes were responsible for 43% of infant deaths and infections for 32% (Table 1). In this group of deaths due to infections, respiratory infections and diarrhea were equally important, each accounting for 12% of deaths. Malformations were the third most important cause (13%), followed by ill defined causes (11%). In this group, nine (4%) cases were presumed sudden infant deaths.

### Risks of Infant Deaths According to Birth Weight and Groups of Causes

More than half (53%) of the infants who died were of low birth weight (LBW), whereas 8–8% of the whole cohort were of LBW. Table 1 shows the cause specific relative risks of death associated with LBW. LBW infants were 35.9 times more likely to die due to perinatal causes than babies of appropriate birth weight. For infectious causes, the relative risks of infant mortality associated with LBW were 6.7 (95% confidence intervals =3.0–14.9) for respiratory infections, 2.5 (95% confidence intervals=0.9–6.7) for diarrhea, and 2.9 (95% confidence intervals=1.0–8.3) for other infections. We also calculated what would be the reduction in the cause specific and overall infant mortality if the incidence of low birth weight was reduced from the present 8.8% to 5%, which is the goal set for the United States for 1990. If that occurred a reduction of 20% in infant mortality would be expected. This reduction would be 33% for deaths due to perinatal causes, 14% for respiratory infections, and only 5% for diarrhea.

Table 2 shows the risks of death associated with LBW at different ages during the first year. LBW babies comprised 71% of babies who died in the neonatal period and were 23.9 times more likely to

### Table 1 Infant Mortality in Pelotas, Brazil, 1982–83, showing causes of death, relative risks associated with low birth weight, and estimated reduction in infant mortality if the incidence of low birth weight was reduced to 5%

<table>
<thead>
<tr>
<th>Causes of death</th>
<th>No (%)</th>
<th>Rate/1000</th>
<th>Relative risk associated with low birth weight (95% confidence intervals)</th>
<th>% Reduction in mortality assuming low birth weight reduced to 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perinatal*</td>
<td>92 (43)</td>
<td>16.6</td>
<td>35.9 (25.9–49.6)</td>
<td>33</td>
</tr>
<tr>
<td>Malformations</td>
<td>27 (13)</td>
<td>4.9</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Respiratory infections</td>
<td>25 (12)</td>
<td>4.5</td>
<td>6.7 (3.0–14.9)</td>
<td>14</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>25 (12)</td>
<td>4.5</td>
<td>2.5 (0.9–6.7)</td>
<td>5</td>
</tr>
<tr>
<td>Ill defined†</td>
<td>24 (11)</td>
<td>4.3</td>
<td>5.0 (2.3–10.8)</td>
<td>12</td>
</tr>
<tr>
<td>Other infections†</td>
<td>18 (8)</td>
<td>3.3</td>
<td>2.9 (1.0–8.3)</td>
<td>6</td>
</tr>
<tr>
<td>Other causes</td>
<td>4 (2)</td>
<td>0.7</td>
<td>3.3 (0.4–28.1)</td>
<td>3</td>
</tr>
<tr>
<td>All causes</td>
<td>215 (100)</td>
<td>38.8</td>
<td>11.0 (8.7–14.4)</td>
<td>20</td>
</tr>
</tbody>
</table>

* Immaturity and hyaline membrane (60 cases), asphyxia (16), infections (12), and other causes (four).
† Presumed sudden infant death syndrome (nine cases) and other ill defined diseases not helped by doctors (15).
‡ Sepsis (14 cases) and meningitis (four).
Table 2  Infant mortality at different ages in the first year of life, showing relative risks associated with low birth weight and estimated reduction in infant mortality if low birth weight was reduced to 5%  

<table>
<thead>
<tr>
<th>Period and age at death</th>
<th>No (%)</th>
<th>Rate/1000</th>
<th>Relative risk associated with low birth weight (95% confidence intervals)</th>
<th>% Reduction in mortality assuming low birth weight reduced to 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early neonatal (0-6 days)</td>
<td>96 (45)</td>
<td>17.3</td>
<td>26.8 (19.6-36.8)</td>
<td>30</td>
</tr>
<tr>
<td>Late neonatal (7-27 days)</td>
<td>23 (10)</td>
<td>4.2</td>
<td>15.5 (8.6-29.1)</td>
<td>23</td>
</tr>
<tr>
<td>Neonatal (0-27 days)</td>
<td>119 (55)</td>
<td>21.5</td>
<td>23.9 (18.0-31.9)</td>
<td>29</td>
</tr>
<tr>
<td>Early post-neonatal (1-5 months)</td>
<td>68 (32)</td>
<td>12.3</td>
<td>5.1 (3.2-8.1)</td>
<td>11</td>
</tr>
<tr>
<td>Late post-neonatal (6-11 months)</td>
<td>28 (13)</td>
<td>5.0</td>
<td>2.7 (1.1-6.5)</td>
<td>6</td>
</tr>
<tr>
<td>Post-neonatal (1-11 months)</td>
<td>96 (45)</td>
<td>17.3</td>
<td>4.3 (2.9-6.5)</td>
<td>10</td>
</tr>
<tr>
<td>Infant (0-11 months)</td>
<td>215 (100)</td>
<td>38.8</td>
<td>11.0 (8.7-13.9)</td>
<td>20</td>
</tr>
</tbody>
</table>

die in the first month than babies with birth weights of 2500 g or more. The reduction in incidence of LBW from 8.8% to 5% would, theoretically, reduce neonatal mortality by 29%. As expected, LBW infants comprised a lower proportion (30%) of postneonatal deaths, the relative risk of postneonatal death associated with LBW being 4.3 (95% confidence intervals=2.9-6.5). The predicted reduction of deaths in this period associated with the reduction of LBW to 5%, therefore, would be only 10%

Age distribution of infant deaths by groups of causes. Table 2 shows that 45% of infant deaths occurred during the first week of life (17% during the first day) and an additional 10% were late neonatal deaths (7-27 days). Deaths in the first six months of life accounted for 87% of the total infant mortality. Table 3 shows that the excess of deaths in the first month of life was due largely to perinatal causes. In fact, all but two of the deaths from perinatal causes occurred in the first four weeks of life, and 90% occurred during the first week. In addition, 67% of deaths caused by malformations occurred in the first month. A somewhat different pattern of age distribution was observed for the remaining causes. After deaths from perinatal causes and malformations had been excluded only 11% of deaths occurred in the neonatal period, whereas 62% occurred in the early post-neonatal period (1-5 months). For infectious causes, 64% of deaths caused by respiratory infections, 84% by diarrhoea, and 78% by other infections occurred in the first six months.

Discussion

An advantage of this population based cohort study was that it derived the number and causes of infant deaths not only from official information but also from interviews with the parents of the dead infants and from reviews of hospital case notes, death certificates, and postmortem examinations. This emphasis on the careful ascertainment of the causes of death resulted from the findings of previous studies in Latin America, which have shown that many diagnoses contained in death certificates do not agree with other clinical information.2

Although this study was carried out in an urban area of a middle income country, and deaths occurred predominantly in hospitals, 24% of the deaths failed to reach the official death registration system. This shows that this system needs to be thoroughly revised and reinforces the need for using alternative sources of information in studies of infant mortality.

A better understanding of the causes of infant deaths in Pelotas may be obtained by a comparison with other countries. In Table 4 we compare our cause specific distribution of infant deaths with that of England and Wales in 1980.9 The infant mortality was 3-4 times higher in Pelotas than in England and
Wales, and in both places perinatal causes ranked first in importance, accounting for about 40% of infant deaths. The mortality from perinatal causes was 3-7 times higher, however, in Pelotas than in England and Wales. As the differences in the incidence of low birth weight are not so pronounced (8-8% and 6-8%, respectively) it seems that this higher mortality can be largely ascribed to inadequacies in perinatal health care. It is therefore important to improve perinatal care, which means increasing the coverage and quality of antenatal care, the management of high risk mothers during labour and delivery, and the help being given to newborns in the delivery room. These goals are in conflict with the situation currently seen in Pelotas and many other Third World cities, where the best trained doctors are more often involved in delivering low risk mothers and looking after their babies, whereas high risk mothers are usually helped by less well trained midwives. 10 11

Infectious diseases represented the second most important cause of death in Pelotas, being 8-7 times more common than in Britain. In fact, the infant mortality from infectious causes in Pelotas (12.2/1000) was higher than the overall infant mortality in Britain (11.4/1000). A large proportion of these deaths due to infectious diseases may be prevented through environmental and nutritional improvements as well as through better health care.

With regard to the age distribution of infant deaths, 87% occurred in the first six months of life, even higher than the 79% described by Puffer and Serrano for 13 projects in eight Latin American countries 2 and the 80% reported for Ghana. 12 When only non-perinatal causes are considered the proportion of infant deaths occurring in the first six months is still high (77%). This indicates that most of the preventive efforts of health workers should be concentrated on this period of increased risk.

We estimated a likely reduction of only 20% in the infant mortality if the incidence of low birth weight in Pelotas was reduced to 5%, which is a rather ambitious goal. For non-perinatal causes of death, this reduction would be even smaller (11%). The prevention of low birth weight is a top priority for further reducing the infant mortality in developed countries, where many of the environmental and health care problems have already been solved. 8 13 14 In places like Pelotas, however, environmental changes and improvements in the quality and coverage of the health care system are probably more important than trying to reduce the incidence of low birth weight.

On the other hand, in terms of case management at health clinics, there is no doubt that low birth weight is an important risk marker, as low birth-weight infants have an increased risk of dying. Health workers at the primary level must keep close contact with such infants, especially during the first six months.

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References

Table 4 Infant mortalities according to cause. A comparison between Pelotas, Brazil (1982-3), and England and Wales (1980) 9

<table>
<thead>
<tr>
<th>Causes of death</th>
<th>Infant mortality Pelotas</th>
<th>Infant mortality England and Wales</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perinatal</td>
<td>16.6</td>
<td>4.5</td>
<td>3.7</td>
</tr>
<tr>
<td>Infections</td>
<td>12.2</td>
<td>1.4</td>
<td>8.7</td>
</tr>
<tr>
<td>Malformations</td>
<td>4.9</td>
<td>3.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Ill defined</td>
<td>4.3</td>
<td>1.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Other causes</td>
<td>0.7</td>
<td>1.0</td>
<td>0.7</td>
</tr>
<tr>
<td>All causes</td>
<td>38.8</td>
<td>11.4</td>
<td>3.4</td>
</tr>
</tbody>
</table>

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